

DIVISION 7 STORM DRAIN, CULVERTS, SANITARY AND COMBINED SEWERS, WATER MAINS AND RELATED STRUCTURES

SECTION 7-01 DRAINS

7-01.1 DESCRIPTION

Section 7-01 describes work consisting of constructing subsurface drains in accordance with the Contract. This work shall include installation of solid and perforated pipe, filter Material, filter fabric (geotextile), sidewalk drains, and gravel drains. Subsurface drains shall be constructed of gravel filter Material and may include perforated pipe and filter fabric as detailed on the Drawings.

7-01.2 MATERIALS

Materials shall meet the requirements of the following Sections:

Gravel Backfill for Drains	9-03.12
Filter Material	9-03.12(4)
Joints, Rubber Gaskets	9-04.4
Pipe and Tubing	9-05
Geotextiles	9-37

Notes: Unless indicated otherwise in the Contract (all pipe sizes are inside diameter):

1. Corrugated Polyethylene Drainage Tubing Drain Pipe shall be limited to less than 10 inch.
2. Corrugated Polyethylene Drain Pipe shall be limited to 12 inch minimum to 36 inch maximum.
3. Perforated PVC Subsurface Drain Pipe shall be limited to a maximum 8 inch.

All reference to filter fabric shall be construed to mean a geotextile Material as specified in Section 9-37, Geotextile, Underground Drainage, Low Survivability, Class to be specified in Contract.

7-01.3 CONSTRUCTION REQUIREMENTS

7-01.3(1) EXCAVATION

Trenching is subject to the provisions of 7-17.3(1). Work in excavations over 4 feet deep are subject to the provisions of Section 7-17.3(1)A7a, Trench Safety Systems.

A trench shall be excavated to the grade, line, and dimensions indicated on the Drawings. The subsurface drain pipe shall be installed with watertight rubber gasketed joint.

The subsurface drain trench shall be dug to the required alignment and grade only as far in advance of pipe installing as the Engineer will approve.

The clear width of trench measured at the springline of the pipe in place shall be 24 inches, or 1 foot greater than the outside diameter of the pipe, whichever is the greater. Standard Plan no. 284 trench width is not applicable to drain pipe and subsurface drain pipe.

There shall be no mixing of filter Material with backfill Material. See Section 2-03.3(10) regarding selected Material.

7-01.3(2) PLACING PIPE AND FILTER MATERIAL

See Section 2-12.3(2) for construction requirements for other than subsurface drains.

The filter Material for pipe shall be damp when placed in the trench and shall be deposited uniformly on both sides of the pipe for the full width of the trench and to the springline of the pipe. The Material shall be tamped in 4-inch lifts to provide thorough compaction under and on each side of the pipe. Succeeding lifts of gravel shall be deposited in 8-inch lifts and be thoroughly compacted to the depth shown on the Drawings.

The geotextile shall be placed in the manner and at the locations as indicated in the Contract. The surface to receive the geotextile, and the trench into which the geotextile is to be placed, shall be free of obstructions and debris.

Should the geotextile be damaged during construction, the torn or punctured section shall be repaired by placing a piece of geotextile of sufficient size to cover the damaged area including a minimum 12 inch overlap with all surrounding geotextile. In places where the trench width is less than 1 foot, the minimum overlap shall be the trench width.

The Contractor shall construct sidewalk drains where indicated in the Contract in accordance with Standard Plan 241b. Pipe shall be placed under the sidewalk in 1 pipe length and shall extend across the planting area to the pavement gutter line at the face of curb. Where curb exists or new curb is to be installed, the curb side terminus of the drain pipe shall be encased in a 14-inch x 24-inch reinforced cement concrete curb block of the depth indicated in the Contract.

Subsurface drains, as specified in Section 9-05.3, shall be located as shown in the Contract.

Clearances between drains and other utilities shall be maintained per Section 1-07.17(2).

When it is necessary to intercept water flowing underneath pavement, the subsurface drain shall be constructed as detailed in the Contract.

All drain pipe shall be installed with the bell or larger end upstream, and shall be open, clean, clear of debris, and free draining.

7-01.3(3) JOINTS

Polyvinyl chloride (PVC) drain pipe shall be installed upstream with the bell end upstream. Corrugated polyethylene drain pipe shall be jointed with snap-on, screw-on, or wraparound coupling bands as recommended by the pipe manufacturer.

7-01.4 MEASUREMENT

Bid items of Work completed pursuant to the Contract will be measured as provided in Section 1-09.1, Measurement of Quantities, unless otherwise provided for by individual measurement paragraphs herein this Section.

Measurement for "Filter Material, (Type)" will be per cubic yard based on the neat line cross section indicated on the Drawings.

Measurement for geotextile will be as specified in Section 2-12.4.

No Measurement will be made for the reinforced concrete curb block at the curb face.

Measurement for "Pipe, Subsurface Drain, (Material), (Size)" and for "Sidewalk Drain, 4-Inch, Type 281" will be by the linear foot measured along the centerline of the pipe from pipe end to pipe end.

7-01.5 PAYMENT

Compensation for the cost necessary to complete the work described in Section 7-01 will be made at the Bid item prices Bid only for the Bid items listed or referenced as follows:

1. **"Pipe, Subsurface Drain, (Material), (Size)"**, per linear foot.

The Bid item price for "Pipe, Subsurface Drain, (Material), (Size)" shall include all costs for the work required to furnish and install the pipe, excavate the pipe trench, haul and dispose of excess excavated Material.

2. **"Filter Material, (Type)"**, per cubic yard.

The Bid item price for "Filter Material, (Type)" shall include all costs for the work required to furnish, install, and compact the Mineral Aggregate filter Material specified on the Drawings, and shall also include, when the subsurface drain is constructed of only gravel filter Material, the costs of the work required to excavate the trench and to haul and dispose of excess excavated Material.

3. **"Sidewalk Drain, (Size), (Material)"**, per linear foot.

The Bid item price for "Sidewalk Drain, (Size), (Material)" shall include all costs for the work required to furnish and install the drain pipe with intake screen and the reinforced concrete curb block, excavation and backfill, saw cut and remove the existing curb. It shall also include excavation at the inlet end of the pipe to make a gravel drain that has minimum dimensions of 12 inch wide by 12 inch deep by 3 feet in length.

4. **"Gravel Drain, (Type)"**, per linear foot.

The Bid item price for "Gravel Drain, (Type)" shall include all costs for the work required to excavate a trench 12 inches wide, fill it with Mineral Aggregate filter Material to a depth of 12 inches, haul and dispose of excess excavated Material and backfill trench with suitable excavated Material.

5. **Other payment information.**

Any part of the trench excavated below grade or to a greater width than specified in the Contract shall be backfilled with filter Material as specified in the Contract at the Contractor's sole expense.

Payment for geotextile will be in accordance with Section 2-12.5.

SECTION 7-02 CULVERTS**7-02.1 DESCRIPTION**

Section 7-02 describes work consisting of constructing Culverts of the various types and classes indicated in the Standard Plans, and at locations and as otherwise indicated in the Contract.

7-02.2 MATERIALS

Materials shall meet the requirements of the following Sections:

Mortar and Grout	9-04.3
Pipe	9-05
Junction Box	9-12.9

Where steel or aluminum Culvert pipe, pipe arch, or end sections are referred to in this Section, it shall be understood that steel is zinc coated (galvanized) or aluminum coated (aluminized) corrugated iron or steel (see Section 9-05.9), and aluminum is corrugated aluminum alloy (see Section 9-05.6).

The class of concrete pipe, or the thickness of steel or aluminum pipe, or pipe arch shall be the same for the entire length of the Culvert, and shall be required using as a basis the maximum height of cover indicated on the Drawings.

Beveled end sections shall be of the same Material as the Culvert pipe to which they are attached.

Box Culvert shall be in accordance with the Drawings.

7-02.3 CONSTRUCTION REQUIREMENTS**7-02.3(1) PLACING CULVERT PIPE****7-02.3(1)A GENERAL**

A trench shall be excavated to the alignment, depth, and grade shown on the Drawings. Excavations over 4 feet deep and Culvert work in ditches and channels over 4 feet deep are subject to the provisions of Section 7-17.3(1)A7a, Trench Safety Systems.

Proper preparation of foundation, placement of foundation Material where required, and placement of the first lift of bedding Material shall precede the installation of all Culvert pipe. This shall include necessary leveling of the native trench bottom, or leveling the top of the foundation Material where required, as well as placement and compaction of required backfill Material to a uniform grade so that the entire length of pipe is uniformly supported on a uniformly dense and unyielding base.

Material meeting the requirements of gravel backfill for pipe bedding, when required in the Contract, shall be placed under the pipe and along the sides of the pipe in accordance with Standard Plan no. 285. Bedding shall be placed in two or more lifts. The first lift shall be placed, spread, and compacted to a uniform thickness of 4 inches or 6 inches (as indicated on Standard Plan no. 285) before the pipe is installed so that the pipe is uniformly supported along the barrel. Subsequent lifts of pipe bedding, of not more than 6 inches in thickness, shall be placed and compacted along the sides to the height shown in Standard Plan no. 285. Lifts shall be brought up evenly on both sides of the pipe and shall be worked carefully under the pipe haunches and then compacted. If the Engineer determines that the Material existing in the bottom of the trench is acceptable for bedding the pipe, gravel backfill for pipe bedding will not be required. In this case, the existing native Material shall be loosened and stockpiled for reuse as bedding, and the bottom regraded and compacted to form a dense and unyielding base.

When indicated in the Contract, a dike or plug of impervious Material shall be placed near the intake end of the Culvert to prevent piping. The dike shall be 2 feet long and adequately placed around the pipe into native material to form an impervious barrier. When suitable impervious Materials are not available at the site, suitable backfill shall be obtained as provided in Section 2-09.3(1)E.

Where pipe is to be placed in a new embankment, the embankment shall be constructed for a distance each side of the pipe location of not less than five times the diameter of the pipe and to a minimum height above the pipe equal to 1/2 the outside diameter of the pipe. The embankment Material shall be compacted to 95 percent of maximum density, and the moisture content at the time of compaction shall be between optimum and 3 percentage points below optimum as determined by the Compaction Control Tests specified in Section 2-03.3(14)E. The trench shall then be excavated to a width as indicated in Standard Plan no. 284 and the pipe installed and backfill compacted in accordance with Section 7-17.3(3).

The ends of the pipe, box or pipe arch shall be rigidly supported to prevent movement before and during the construction of end walls or headers.

Culverts shall not extend beyond the staked limits.

Culvert pipe shall be constructed within the same tolerance limits as specified for Sewer pipes in Section 7-17.3(2)B.

All Culverts and end sections shall be open, clean, and free draining.

If the Contractor proposes an alternate pipe installation, Shop Drawings for the alternate shall be submitted to the Engineer for approval prior to procuring or constructing the alternate.

Pipe installed under side road connections, where the depth of cover is less than 2 feet, shall not be of the bell and spigot type, but shall have beveled ends.

7-02.3(1)B PLACING CONCRETE PIPE**7-02.3(1)B1 GENERAL**

In the trench, concrete pipe shall be installed beginning at the lower end, with the bell or groove end up grade. For pipe with elliptical reinforcement, the minor axis of reinforcement shall be in a vertical position.

When it is necessary to connect dissimilar pipe, an adapter coupling shall be used as detailed on the Drawings.

7-02.3(1)B2 RUBBER GASKETED JOINTS

In installing concrete pipe with rubber gaskets, the bottom of the trench shall be dewatered, firm, and free of loose material so that joining can be accomplished without contaminating the joint with soil or other deleterious material.

Pipe with affixed gaskets shall be handled carefully to avoid knocking the gasket out of position or contaminating it with foreign Material. Any gasket so disturbed shall be removed, cleaned, relubricated if required, and replaced before joining the pipe sections.

The pipe shall be properly aligned before joints are forced home. Sufficient pressure shall be applied in making the joint to ensure that the joint is home, as defined in the standard installation instructions provided by the pipe manufacturer. The Contractor may use any method recommended by the pipe manufacturer and acceptable to the Engineer for pulling the pipe together, except that driving or ramming by hand or machinery will not be permitted. Any pipe damaged during joining and joint tightening shall be removed and replaced at no expense to the Owner.

Sufficient restraint shall be applied to the line to ensure that joints once home remain undisturbed. At the end of the Day's work, the last pipe section shall be braced to prevent creep.

7-02.3(1)B3 HAND MORTARED JOINTS

On bell and spigot type pipe, the lower portion of the bell shall be filled with stiff mortar, composed of one part Portland cement and three parts fine sand and shall be sufficiently thick to make the inner surfaces of the abutting sections flush and even as the pipe is installed. On tongue and groove pipe, the lower 1/2 of the groove and the upper 1/2 of the tongue shall be coated with a thin layer of mortar composed of one part Portland cement and two parts fine sand. The use of aluminum powder or calcium chloride in any mortar will not be allowed. After covering the ends with mortar, the spigot end (or tongue end) shall be inserted into the bell (or groove) as far as the construction of the pipe permits.

After each section of the pipe is installed, uniformly matched, and the sections fitted as close as the construction of the pipe permits, the joint, both inside and out, shall be filled and sealed with the mortar mix as specified in the previous paragraph. After sealing, the joint on the inside of the pipe shall be cleaned of all surplus mortar and smoothed flush to match the shape of surrounding surface. The mortar outside the pipe shall be properly cured by covering with polyethylene sheeting, damp sand, or spraying with curing compound; the Culvert shall not be backfilled until the mortar has set for at least 24 hours.

7-02.3(1)B4 ELLIPTICAL REINFORCEMENT

In lieu of marking circular pipe with elliptical reinforcement in accordance with ASTM C 76, the location of the top of the pipe shall be indicated by 3-inch wide, waterproof, painted stripes on the inside and outside of the pipe for a distance of 2 feet from each end of the pipe section.

7-02.3(1)C PLACING STEEL OR ALUMINUM PIPE**7-02.3(1)C1 GENERAL**

Metal pipe and metal pipe arch shall be placed in a trench prepared as specified in Section 7-02.3(1)A. Separate sections of the pipe shall be installed in the trench with the outside laps of circumferential joints upgrade and with longitudinal laps positioned other than in the invert, and firmly joined together with approved bands.

7-02.3(1)C2 INSTALLATION OF METAL END SECTIONS**7-02.3(1)C2a GENERAL**

Metal end sections shall be installed in accordance with WSDOT Standard Plan nos. B-7 and B-7a.

7-02.3(1)C2b RESERVED**7-02.3(1)C2c MITERED ENDS**

The ends of steel Culvert pipe or pipe arch shall not be beveled unless specified otherwise in the Contract. If beveled ends are specified, the ends of Culvert pipe over 30 inches in diameter shall be mitered to conform to the slope of the embankment in which the Culvert is to be placed whether the Culvert is constructed normal to or at an angle with the centerline of the roadway.

Beveled steel pipe end sections 12 inches through 30 inches in diameter shall be of the same Material and thickness and have the same protective coating as the pipe to which they are attached. Beveled pipe ends of these dimensions shall be constructed in accordance with WSDOT Standard Plan no. B-7a.

7-02.3(1)C3 PROTECTIVE TREATMENT**7-02.3(1)C3a TREATMENT OF STEEL PIPE**

Steel pipe and pipe arch Culverts shall be coated by one of the following protective treatments, when such treatment is required in the Contract:

Treatment 1	Coated uniformly inside and out with asphalt.
Treatment 2	Coated uniformly inside and out with asphalt and with an asphalt paved invert.
Treatment 3	Coated inside & out with fibers embedded in the spelter coating, then covered on both sides with asphalt.
Treatment 4	Coated as in Treatment 3 and with an asphalt paved invert.
Treatment 5	Coated inside and out with asphalt and a 100 percent periphery inside spun asphalt lining.
Treatment 6	Coated as in Treatment 3 and with a 100 percent periphery inside spun asphalt lining.

7-02.3(1)C3b TREATMENT OF ALUMINUM PIPE

When plain aluminum pipe or pipe arch is used where it makes contact with Portland cement concrete or concrete pipe, all aluminum surfaces in contact with, and to 1 foot beyond the contact zone with the concrete or concrete pipe shall be cleaned and painted with two coats of paint. The aluminum pipe to be painted shall be cleaned with solvent to remove contaminants. After cleaning, the pipe shall be painted with two coats of paint conforming to Federal Specification TT-P-645 (Primer, Paint, Zinc Chromate, Alkyd Vehicle).

7-02.3(2) JUNCTION BOX

Junction boxes shall be only used where private storm service drain, or other small diameter storm pipe, needs to be connected with an existing Culvert. Sanitary, or combined storm and sanitary, connections will not be allowed with a Culvert system or with a junction box to a Culvert system. Junction box shall be installed as shown on the Drawings. See Standard Plan no. 277 and Section 9-12.9.

7-02.3(3) BACKFILLING

Placement and compaction of backfill Material above the bedding zone shall be performed in accordance with the requirements specified in Section 7-17.3(3) Backfilling Trenches.

The Contractor shall not operate tractors or other heavy equipment over the Culvert until it has been backfilled as provided above, or until the embankment has reached a height of 2 feet above the top of the Culvert, or as provided in Section 1-07.7 if the site of the Culvert is at a location where legal highway load limitations are not in effect.

7-02.3(4) REMOVING AND REINSTALLING CULVERTS

In the case of concrete pipe, all joints of the pipe before being reinstalled shall be cleaned so as to be free from all adhering Materials, including old mortar placed as a collar or seal in the original construction.

All Culvert sections removed and not reinstalled shall become the property of the Contractor.

7-02.3(5) PLUGGING EXISTING CULVERTS

Where shown on the Drawings, existing Culverts shall be plugged on the inlet end as specified in Section 2-02.3(5). Culvert to be abandoned and filled shall be as specified in Section 2-02.3(5).

7-02.3(6) FISH PASSAGE AT CULVERTS

Where the Work included culverts that accommodate fish passage, the construction will be as specified in the Contract.

7-02.4 MEASUREMENT

Bid items of Work completed pursuant to the Contract will be measured as provided in Section 1-09.1, Measurement of Quantities, unless otherwise provided for by individual measurement paragraphs herein this Section.

Measurement for Junction Box will be per each.

Measurement of Culvert pipe, box Culvert, or pipe arch Culvert will be the number of linear feet of completed installation measured along the invert.

Measurement of beveled end sections will be considered as part of the Culvert pipe, box Culvert, or pipe arch Culvert and will be measured as part of Culvert pipe, box Culvert, or pipe arch Culvert.

Embankment construction before Culvert placement under the applicable provisions of Section 7-02.3(1) will be measured in accordance with Section 2-03.

7-02.5 PAYMENT

Compensation for the cost necessary to complete the work described in Section 7-02 will be made at the Bid item prices Bid only for the Bid items listed or referenced as follows:

1. "Pipe, Culvert, (Material), (Class), (Size)", per linear foot.
2. "Pipe Arch, (Material), (Class), (Size)", per linear foot.

The Bid item prices for "Pipe, Culvert, (Material), (Class), (Size)" and for "Pipe Arch, (Material), (Class), (Size)" shall include all cost for the work required to furnish and install Culvert pipe and pipe arch, as specified in Section 7-02 including beveled end sections when required and final cleaning of the Culvert.

3. "Junction Box", per each.

The Bid item price for "Junction Box" shall include all cost for the work required to furnish and install the junction box complete to finish grade including but not limited to excavation, mortar, grout, brick, block, castings, and backfill with suitable native material.

4. Other payment information.

Where Culvert pipes are to be removed and are not to be reinstalled, see Section 2-02.5 for payment.

No payment will be made for plugging existing pipes. See Section 2-02.5.

Alternate pipe installations to that shown on the Drawings and approved by the Engineer shall have no increase in the Bid item price to the Owner.

All costs involved in storing, protecting, re-handling, disposing, and/or placing the excavated Material shall be included in the applicable Bid items of Work.

All costs of cleaning and painting aluminum pipe surfaces as specified in Section 7-02.3(1)C3b shall be included in the Bid item price for the aluminum pipe or pipe arch.

Payment for Section 7-02.3(1)C3a treatment shall be incidental to the Bid item price for the aluminum pipe or pipe arch and no separate or additional payment will be made therefore.

Payment for trench safety systems, when applicable, will be as specified in Section 7-17.5.

SECTION 7-03 STRUCTURAL PLATE PIPE, PIPE ARCH, ARCH, AND UNDERPASS**7-03.1 DESCRIPTION**

Section 7-03 describes work consisting of constructing structural plate pipe, pipe arches, arches, and underpasses of various types and designs in accordance with WSDOT Standard Plan nos. B-8 and B-8a, and as specified in Contract, and at the locations and grades indicated on the Drawings.

Structural plate pipes shall be full circle of the type, gauge or thickness, and diameter specified in the Contract. Structural plate pipe arches shall be a multi-centered shape made up of four circular arcs tangent to each other at their junctions and symmetrical about the vertical axis and of the type, gage or thickness, and span specified in the Contract.

Structural plate arches shall be a single-centered circular arc shape, placed on a reinforced concrete foundation, and of the design, type, gage or thickness, and span as provided for in the Contract.

Structural plate underpasses shall be a multi-centered shape made up of a variable number of circular arcs tangent to each other at their junctions and symmetrical about the vertical axis and of the design, type, gage or thickness, and span specified in the Contract.

Structural plate pipe, pipe arches, arches, and underpass work in ditches, channels, and trench excavations over 4 feet deep are subject to the provisions of Section 7-17.3(1)A7a, Trench Safety Systems.

7-03.2 MATERIALS

Materials shall meet the requirements of the following Sections:

Concrete Class 3000	6-02.3
Pipe, Pipe Arch, Arch, and Underpass	9-05
Reinforcing Steel	9-07

Bolts and bolted connections shall conform to AASHTO M 167 for steel and to AASHTO M 219 for aluminum.

7-03.3 CONSTRUCTION REQUIREMENTS

7-03.3(1) FOUNDATIONS

7-03.3(1)A GENERAL

Structural plate pipes, pipe arches, underpasses, and bases for arches shall be placed on stable foundations prepared to the widths, depth, and grade as shown on the Drawings. Soft spots encountered in the foundation shall be excavated to a depth, and backfilled and compacted with Material as indicated in the Contract.

Rock, in either ledge or boulder formation, hard pan, or cemented gravel occurring in the base material shall be excavated below grade and backfilled with suitable Material to provide a minimum 8-inch cushion under the pipes, pipe arches, or underpasses.

Concrete required for constructing structural plate arch foundations shall be Class 3000 concrete in conformance with the requirements of Section 6-02.3.

7-03.3(1)B STRUCTURAL PLATE PIPE, PIPE ARCH, AND UNDERPASS

The foundation for structural plate pipes, pipe arches, and underpasses, shall be shaped to conform to their bottom form, and shall form firm and uniform bearing throughout their length. Where pipes, pipe arches, or underpasses are to be installed in new embankment, the embankment shall be constructed to the 1/3-point of structural plate pipes (measured from the invert of the pipe), to the height of maximum horizontal dimension of structural plate pipe arches as provided for in WSDOT Standard Plan nos. B-8 and B-8a, and in the case of a special design, as indicated on the Drawings, after which the trench shall be excavated and installation made.

The ends of structural plate pipes, pipe arches, arches, or underpasses, shall not be mitered unless indicated otherwise in the Contract. If mitered ends are specified, the slope shall conform to the slope of the embankment in which the Culvert is to be placed and shall be limited to the top arc only.

7-03.3(1)C STRUCTURAL PLATE ARCH

The base for structural plate arches shall be as shown on the Drawings.

7-03.3(2) ASSEMBLING

Structural plate pipes, pipe arches, arches, and underpasses shall be assembled in place in accordance with the manufacturer's instructions, which shall accompany the shipment of Materials and show the position of each plate and the order of assembly. The Contractor shall submit the manufacturer's instructions at least 5 Working Days prior to construction.

7-03.3(3) BACKFILLING

After the structural plate pipe, pipe arch, arch, or underpass has been placed in position, it shall be backfilled in accordance with Section 7-02.3(3).

7-03.3(4) FOUNDATION TREATMENT

Earth, or other Material when specified in the Contract, shall be placed and compacted beneath structural plate pipes, pipe arches, or underpasses in conformance with WSDOT Standard Plan no. B-11.

7-03.3(5) HEADWALLS

If headwalls are specified on the Drawings, they shall be constructed as soon as the embankment has been completed to a sufficient height over the structure to allow the required work. Headwalls shall be constructed in accordance with the applicable portions of Section 6-02.

7-03.3(6) ALTERNATE INSTALLATION

If the Contractor proposes an alternate installation, Shop Drawings for the alternate shall be submitted to the Engineer for approval at least 10 Working Days prior to procuring or constructing the alternate. See Section 1-05.3(5).

7-03.4 MEASUREMENT

Bid items of Work completed pursuant to the Contract will be measured as provided in Section 1-09.1, Measurement of Quantities, unless otherwise provided for by individual measurement paragraphs herein this Section.

Measurement of structural plate pipes, pipe arches, arches, and underpasses, will be the number of linear feet of completed installation measured along the invert.

Concrete will be measured by the cubic yard as specified in Section 6-02.4.

Steel reinforcing bars will be measured by the pound as specified in Section 6-02.4.

Structure excavation will be measured by the cubic yard as specified in Section 2-09.4.

Gravel backfill for foundation will be measured by the cubic yard as specified in Section 2-09.4.

7-03.5 PAYMENT

Compensation for the cost necessary to complete the work described in Section 7-03 will be made at the Bid item prices Bid only for the Bid items listed or referenced as follows:

1. "Structural Plate Pipe, (Material), (Thickness), (Diameter)", per linear foot.
2. "Structural Plate Pipe Arch, (Material), (Thickness), (Span)", per linear foot.
3. "Structural Plate Arch, (Material), (Thickness), (Span)", per linear foot.
4. "Underpass, (Design), (Thickness), (Span)", per linear foot.

The Bid item prices for "Structural Plate Pipe, (Material), (Thickness), (Diameter)", for "Structural Plate Pipe Arch, (Material), (Thickness), (Span)", for "Structural Plate Arch, (Material), (Thickness), (Span)", and for "Underpass, (Design), (Thickness), (Span)" of the design, type, gage or thickness, and size specified shall include all costs for the work required to furnish, haul, and assemble in place the completed structure including excavation, stockpiling, disposal, backfilling.

5. **Other payment information.**

Payment for the class of concrete shall be as specified in Section 6-02.5.

Payment for steel reinforcing bar shall be as specified in Section 6-02.5.

Payment for structure excavation shall be as specified in Section 2-09.5.

Payment for imported "Mineral Aggregate, (Type)" backfill shall be per Section 4-01.5.

Payment for trench safety systems will be in accordance with section 7-17.5.

SECTION 7-04 RESERVED**SECTION 7-05 MANHOLES, CATCH BASINS, AND INLETS****7-05.1 DESCRIPTION**

Section 7-05 describes work consisting of constructing manholes, catch basins, inlets, and the rebuilding or rechanneling of existing manholes in accordance with the Contract at locations shown on the Drawings. This work shall also include excavation, and backfilling and compaction as specified in Section 7-17.

Work in trench excavations over 4 feet deep shall comply with Section 7-17.3(1)A7a, Trench Safety Systems.

7-05.2 MATERIALS

Materials shall meet the requirements of the following Sections:

Manholes, Catch Basins, Inlets, Appurtenance, and Related	9-12
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Manholes, catch basins and inlets shall be constructed of pre-cast components in accordance with the following Standard Plan nos.:

Drainage Structure	Standard Plan nos.
Manholes	200a through 207
Catch Basins	240 through 243b
Inlets	250 and 252

Deviations from Standard Plans, other than Material(s) substitutions allowed in Section 9-12, shall be subject to a Shop Drawing submitted by Contractor and approved by the Engineer in accordance with Section 1-05.3(5). Substitution(s) in Materials indicated on the Standard Plans and allowed in Section 9-12 shall comply with the requirements in Section 1-06.1. Concrete masonry units or concrete (masonry) rings may be used for adjustment of the casting to final street grade.

Joints between manhole components shall be rubber gasket.

The concrete mix for manhole channel shall be Class 6 (3/4) (see Section 5-05.3).

Concrete for manhole, catch basin, and inlet structures shall be Class 4000 (see Section 6-02.3).

Precast manhole components shall conform to ASTM C 478 except as modified in Section 7-05.

7-05.3 CONSTRUCTION REQUIREMENTS

7-05.3(1) MANHOLE

7-05.3(1)A FOUNDATION PREPARATION

7-05.3(1)A1 DEWATERING

Dewatering of manhole and catch basin excavations shall comply with the applicable Sections of Section 7-17.3(1)A.

7-05.3(1)A2 FOUNDATION PREPARATION

Adequate foundation support shall be obtained by compacting the existing subgrade to a 95% for a 12 inch depth in accordance with Section 2-03.3(14)E. Where unsuitable foundation conditions exist, removal of unsuitable Material and replacement with compacted suitable or imported Material will be required.

7-05.3(1)B BEDDING

7-05.3(1)B1 BEDDING AND FOUNDATION SUPPORT FOR PRECAST BASE SECTION

Manholes and catch basins constructed with precast base sections shall be placed to grade upon a 6-inch minimum thickness of Mineral Aggregate Type 9 per Section 9-03 mixed with 4 sacks of Portland cement per cubic yard of Mineral Aggregate, with sufficient water added to form a stabilized foundation. The mixed Material shall be placed across the area of the excavation for the base to a minimum distance beyond the face of the manhole as indicated on the Standard Plans and shall be graded to provide uniform bearing support with the precast base section.

7-05.3(1)B2 BEDDING AND FOUNDATION SUPPORT FOR CAST-IN-PLACE BASE SECTION

All cast-in-place bases for manholes and catch basins shall be poured to grade upon a properly prepared foundation as indicated in the Standard Plans. Imported Mineral Aggregate Type 2, when required in the Contract, shall be placed and compacted to the same limits specified in Section 7-05.3(1)B1. The concrete base shall meet the requirements indicated in the Standard Plans.

7-05.3(1)C DIMENSIONS

Manhole types indicated on the Drawings shall conform in all respects to dimensions, and range of dimensions when applicable, as shown on the Standard Plans for each type manhole specified.

7-05.3(1)D REINFORCED CONCRETE

7-05.3(1)D1 CONCRETE MIXTURE

Concrete shall meet the requirements of Section 9-12.1.

7-05.3(1)D2 CURING

Upon completion of concrete casting, the precast components shall be protected and cured in a moist atmosphere maintained by injection of steam for the requisite length of time and at the required temperature to develop the compressive strength required for manhole components.

Precast components may also be water-cured by any approved method that keeps the components continuously moist during the curing period. Cast-in-place components shall be moist cured for a period not less than 7 Days, except that Type III Portland cement concrete shall be cured for not less than 3 Days.

A pigmented membrane curing compound may be applied in lieu of moist curing with prior approval of the Engineer.

7-05.3(1)E BASE

7-05.3(1)E1 GENERAL

Base sections shall conform to the requirements for precast manhole sections in Section 7-05.3(1)F, except that the reinforced base slab shall be made an integral part of the section, and openings for pipe shall be provided to meet job requirements as indicated on the Drawings. The base slab thickness shall be not less than that indicated on the Standard Plans, and on Type 200 and Type 201 manhole the base slab shall be cast monolithically with the wall section or otherwise constructed in such manner as to achieve a completely watertight structure.

Reinforcement of the base slab shall be in accordance with the Standard Plans. The steel shall be placed 1-1/2 inches from the top, and shall extend into the wall of the manhole section and be tied to the longitudinal steel when called for in the Standard Plans. The walls of the base section shall be reinforced in accordance with ASTM C 478. Openings to receive pipe shall be circular, and shall be held to the minimum size possible to accommodate the pipe to be inserted and to effectively seal the joint. Resilient connectors conforming to ASTM C 923 may be used at the Contractor's option.

7-05.3(1)E2 PRECAST BASE

The base section shall be carefully placed on the prepared bedding so as to be fully and uniformly supported in true alignment and ensuring that all entering pipes can be inserted on proper grade.

All lift holes shall be thoroughly wetted and then completely filled with mortar and smoothed both inside and out to ensure watertightness. All joints between precast sections shall be rubber-gasketed joints.

Precast sections shall be placed and aligned to provide vertical sides and vertical alignment of the ladder rungs. The completed manhole shall be rigid, true to dimensions, and watertight.

In precast manhole sections where steel loops have been provided in lieu of lift holes, the loops shall be removed flush with the inside wall surface after the manhole has been completed. No sharp cutoff protrusion will be permitted. If concrete spalling occurs as a result of the loop removal, the spalled area shall be restored in a workmanlike manner to a uniform smooth surface with mortar.

All precast manhole bases and catch basins shall be manufactured with thin-walled concrete blockouts for pipe connections conforming to pipe size(s) and alignment(s) shown on the Drawings. Blockouts shall contain no reinforcing steel. Removal of reinforcing steel or of any concrete beyond the blockouts shall not be allowed. Openings for pipe connections in manhole types 200, 201, and 202 shall be no less than the outside diameter of pipe plus 4 inches. Openings for pipe connections in manhole types 200, 201, 202, 203, 204, 205, and 206 shall be no larger than the outside diameter of pipe plus the manhole wall thickness.

7-05.3(1)E3 CAST-IN-PLACE BASE

The first precast section shall be placed on the cast-in-place bottom slab and shall be carefully adjusted to true grade and alignment. The bottom slab shall be constructed in accordance with the modified Standard Plans. The Contractor prior to placing the bottom slab of the manhole shall inspect the existing pipe which the manhole is to be built around. If the existing line is in bad condition, the Contractor shall immediately notify the Engineer to replace the pipe. The bottom slab shall not be placed prior to the replacement of the damaged pipe.

The first manhole section shall be uniformly supported by the base concrete, and shall not bear directly on any pipe.

All lift holes and openings around pipes on precast components and cast-in-place bases or Structures shall be thoroughly wetted, completely filled with mortar, and smoothed and pointed both inside and out to ensure watertightness.

Precast sections shall be placed and aligned so as to provide vertical sides and vertical alignment of the ladder rungs. The completed manhole shall be rigid, true to dimension, and watertight.

7-05.3(1)F PRECAST WALL SECTIONS

Reinforcement for standard (riser) sections shall consist of a single cage of steel, placed at the approximate center of the wall section. The cage shall be welded at every circumferential wire, or lapped 40 diameters and tied. The welded splice shall develop a tensile strength of 50,000 psi.

Joints between sections shall be tongue and groove, and shall provide 1/2 inch nominal annular space and a minimum of 1-1/4 inches lap.

No more than two lift holes shall be cast into each section. Holes shall be so located as to not damage reinforcing or expose it to corrosion. At the manufacturer's option, steel loops may be provided for handling, in lieu of lift holes.

Steps shall be installed in each section so that sections placed together in any combination provide a continuous vertical ladder with rungs equally spaced at 12 inches. The lowest rung shall be not more than 16 inches above the shelf.

Steps shall project uniformly from the inside wall of the manhole per Standard Plan no. 232 and shall be cast or firmly grouted in place to ensure complete watertightness. Where it is intended that manholes be installed without fixed steps, the Contract will so specify.

7-05.3(1)G PRECAST CONES

Standard precast cones shall provide reduction in diameter within a range of height from not less than 18 inches to a maximum 24 inches (see the Standard Plans for cone dimensions). Jointing of cone section to the riser sections shall be similar to jointing between riser sections, but the top surface of the cone section shall be flat and at least 5 inches wide, radially, to receive adjustment bricks. Wall thickness shall be 4 inches minimum, and reinforcing shall conform to the requirements specified for standard sections of the larger diameter. Steps shall be provided as specified for standard precast sections, and an additional step or handhold shall be provided in all concrete cones on the side opposite the ladder steps at about midheight of cone section as shown on Standard Plan no. 208.

No more than two lift holes shall be cast into each cone, and they shall be located so they do not damage reinforcing or expose it to corrosion. At the manufacturer's option, steel loops may be provided for handling, in lieu of lift holes.

Handholds (steps) installed in leveling bricks or flat slab shall be modified to allow a minimum clear opening of 21 inches measured at the shortest dimension, but the handhold shall be not less than 3 inches from the inside face of the wall.

7-05.3(1)H FLAT SLAB COVERS

Standard flat slab covers shall be a minimum of 8 inches thick and shall conform to the outer dimension of the standard sections upon which they are to be placed. Details of opening location and reinforcing shall be as shown on the Standard Plans.

7-05.3(1)I FLAT SLAB REDUCTION SECTIONS

Reductions to 24-inch and 48-inch openings can be made by means of a flat slab reducing section as shown on Standard Plan nos. 200 through 206, "b" series only. Standard flat slab covers shall be a minimum of 8 inches thick and shall conform to the outer dimension of the standard sections upon which they are to be placed. Details of opening location and reinforcing shall be as shown on the Standard Plans.

7-05.3(1)J T-TOP PIPE MANHOLES

T-Top pipe manholes shall conform to the Drawings and shall be provided with foundation and bedding.

7-05.3(1)K JOINTS

Joints between precast manhole components shall be rubber gasketed in a manner similar to pipe joints conforming to ASTM C 443. Shop Drawings of joint details in Standard Plan nos. 200b and 201b, and of end details in Standard Plan nos. 202b, 203b, 204b, 205b, and 206b shall be submitted to the Engineer for approval at least 5 Working Days before manufacture. Completed joints shall show no visible leakage and shall conform to the dimensions of ASTM C 478.

7-05.3(1)L SHOP FABRICATED CORRUGATED METAL MANHOLES

Shop fabricated corrugated metal manholes, shall be constructed in accordance with the Drawings. The Contractor shall submit to the Engineer at least 10 Working Days in advance of ordering, Shop Drawings of the corrugated metal manhole. The corrugated metal manhole shall conform to all applicable provisions of these Standard Specifications.

7-05.3(1)M MANHOLE CHANNELS

All manholes shall be channeled unless otherwise specified in Contract.

Manhole channels shall conform to the curvature of the connecting pipes. Manhole channel slopes shall be made to conform accurately to the Sewer grade and shall be brought together smoothly with well rounded junctions. Where pipe connections have differing grades or differing invert elevations or differing inside diameters, a smooth transition in channel grade(s) or side(s) is required. Channel sides for each pipe shall be carried up vertically from the I.D. at the springline to the crown elevation of the pipe. The concrete shelf between channels shall be smoothly finished and warped evenly with slopes to drain.

7-05.3(1)N MANHOLE PIPE CONNECTIONS

All pipes, except CMP, entering or leaving the manhole shall be provided with flexible joints within 1/2 of a pipe inside diameter or 12 inches, whichever is greater, from the outside face of the manhole structure and shall be placed on firmly compacted bedding, particularly within the area of the manhole excavation which normally is deeper than that of the Sewer trench. Openings surrounding pipes entering the manhole shall be completely filled with either a non-shrink cement sand grout and shall be finished flush with the remaining manhole concrete wall surfaces to ensure watertightness. PVC pipe connecting to manhole shall be provided with a manhole adapter complete with gasket and approved by the Engineer.

7-05.3(1)O BACKFILL

Backfill around drainage Structures, such as manholes, catch basins, inlets, and related Structures, shall consist of suitable Material and shall be placed as a backfill in accordance with Section 7-17.3(3).

7-05.3(1)P MANHOLE GRADE ADJUSTMENT

The Contractor shall be responsible for selecting the appropriate precast concrete manhole components, allowing for a maximum height of 2 foot 2 inch from the top of the cone section or top slab to the finished surface grade for installation of the manhole frame and cover including 8 inches minimum for leveling or adjustment brick, or concrete collar. The surface grade for frame and cover on unimproved roadways shall match the adjacent existing roadway surface. On projects calling for regrading and pavement improvements, the grade sheet furnished by the Engineer will show the approximate top grade for manhole within plus or minus 0.2 feet. The final grade will be set by the Engineer.

Final elevation and slope of the frame and cover shall conform to the restored and adjacent street surface. No warping of grades in lieu of manhole frame adjustment will be allowed. All joints in the brick or ring adjustment shall be filled with mortar, and the casting shall be seated in mortar placed on the top brick course. A 3/8-inch thick mortar lining shall be installed inside and outside the adjustment section to provide a smooth, watertight finish.

7-05.3(1)Q LADDER, STEPS AND HANDHOLDS

The Contractor shall submit to the Engineer for approval at least 5 Working Days in advance, the single Material of choice for step, handhold, and ladder from the Section 9-12.2 Materials available, and shall consistently use this single chosen Material in every drainage Structure. Should the Contractor request a different Material between or among different drainage Structures, then the submittal shall be clear in identifying which Material is for which drainage Structure.

Base sections of precast manholes more than 3 feet in height shall be provided with a ladder as detailed in Standard Plan no. 232. Where ladders are required, the bottom step in which the ladder is hung shall be manufactured of the same Material as the ladder.

Steps, handholds, and ladder made of copolymer polypropylene plastic manufactured by Lane International Corp., M. A. Industries, Inc., or approved equal may be substituted for galvanized steel steps, handholds, and ladder.

Where a flat slab is required in the construction of a manhole, the handholds normally required in this area may either be installed in the slab itself, or installed between the slab and leveling bricks, provided that the overall distance to the upper handhold or step, or the distance between the upper handhold or step to the top of frame, is no more than 16 inches. See Sections 7-05.3(1)F and 7-05.3(1)G for additional requirements.

7-05.3(1)R FRAME AND COVER

The casting as shown on Standard Plan no. 230 may be used without extension rings for concrete pavement, or rigid pavement base if the top of casting is level with top of finished pavement and the casting flange is below the rigid pavement. Casting with depth less than the thickness of concrete pavement shall have frame extensions (see Standard Plan no. 231) epoxied to the casting frame by the frame manufacturer to allow the top of casting to be level with the top of finished pavement, and the casting flange to be below the bottom of rigid pavement.

Where Standard Plan no. 230 casting is located within the concrete pavement or within the rigid concrete pavement base, reinforcing in the concrete pavement slab shall be installed as specified in Section 5-05.3(9). Standard Plan no. 230 casting located across, or located within 18 inch of a concrete pavement joint as measured from the casting barrel (not the flange), does not require Section 5-05.3(9) pavement reinforcing.

Total height of casting, ring extension, and leveling brick shall not exceed 26 inches.

7-05.3(1)S CONNECTIONS TO EXISTING MANHOLES

The Contractor shall verify invert elevations prior to construction. Discrepancies in invert elevations shall be immediately brought to the attention of the Engineer. The crown elevation of lateral pipes shall be the same as the crown elevation of the incoming pipe. The existing base shall be reshaped to provide a channel equivalent to that specified for a rechanneled manhole (see Section 7-05.3(1)T).

The Contractor shall excavate completely around the manhole to prevent unbalanced loading. The manhole shall be kept in operation at all times, and the necessary precautions shall be taken to prevent debris or other Material from entering the Sewer. This includes building a tight pipeline sewage bypass as required.

The Contractor shall core drill, line drill or wall saw an opening to match the size of pipe to be inserted. Where line drilling is the method used, the method of drilling holes shall prevent overbreakage. All openings shall provide a minimum of 1 inch and a maximum of 2 inches clearance around the outside circumference of the pipe. Upstream pipes, except PVC pipe, penetrating the walls of manholes shall be placed with the bell facing out such that the bell is placed snug against the outside wall of the manhole as the angle of penetration allows. Pipe, except PVC pipe, leaving or entering manholes shall be provided with a flexible joint within 1/2 of a pipe inside diameter, or 12 inches, whichever is greater from the outside wall of the manhole. After pipes have been placed in their final position, the surface area around the opening in the manhole and the surface of the pipe shall be cleaned of all dirt, dust, grease, oil and other contaminants and then roughened and wetted with water. The opening between pipe and broken out concrete shall be grouted as specified in Section 7-05.3(1)N. PVC pipe connecting to an existing manhole shall be installed according to Section 7-05.3(1)N.

7-05.3(1)T RECHANNEL EXISTING MANHOLE

Rechanneling of an existing manhole shall include all as necessary work, such as, excavating shelf and manhole bottom, filling existing channel or channels with concrete, installing the new channel or channels, constructing new pipe opening or openings, and finishing the channel(s) and shelf(ves). It shall also include the work of connecting the pipe to the manhole in accordance with Section 7-05.3(1)S. Rechanneling shall meet the requirements specified in Section 7-05.3(1)M.

7-05.3(1)U REBUILD EXISTING MANHOLE

Where noted on the Drawings, the Contractor shall rebuild the existing manhole per Standard Plan no. 208 to accommodate a new manhole frame and cover meeting the requirements of Standard Plan no. 230. Work required to rebuild an existing manhole includes excavation around the manhole; removal and salvage of the existing manhole frame and cover; removal of leveling or adjustment bricks or rings; and removal of the upper portion of the cone section to a depth yielding an opening of inside diameter as indicated on Standard Plan no. 208. The cone section shall be rebuilt; leveling bricks or rings installed; new manhole steps and handholds installed meeting the requirements of Sections 7-05.3(1)F or 7-05.3(1)G, and a new frame and cover installed in accordance with Section 7-05.3(1)R.

Excavation, backfill with suitable Material, and compaction shall conform to the applicable portions of Section 7-17. Salvage shall be in accordance with Section 2-02.3(7).

7-05.3(2) CATCH BASINS AND INLETS

7-05.3(2)A GENERAL

Construction requirements for catch basins and inlets shall follow all applicable Specifications of Section 7-05.3(1) for manholes and manhole pipe connections with the exception that no channeling is required. The "joint details by Contractor" in Standard Plan no. 243a shall be submitted by the Contractor to the Engineer for approval at least 5 Working Days in advance of ordering the catch basin.

Catch basins shall be installed as indicated on Standard Plan nos. 260a and 260b unless the Contract indicates otherwise.

Catch basin shall be installed at an elevation which provides at least 2 feet 8 inches of clearance between the outlet pipe and the bottom of the basin. Connections to the catch basin shall be made only either at the pre-drilled holes or at the concrete knock outs provided in the walls of the catch basin. In order to meet this requirement, the Contractor shall determine beforehand the approximate elevation of the proposed inflow and outflow pipes by taking into account the length of inlet connection pipe, the throw in the roadway, and any existing utilities or obstructions that may interfere with installing the inlet connection pipe. All these items have a bearing on the depth of the inlet pipe at the catch basin, and the bottom elevation of the catch basin.

Where it is necessary for the Contractor to set the catch basin deeper to accommodate the deeper incoming pipe, the additional depth of the catch basin requires additional rows of leveling or adjustment bricks, up to a maximum of 16 inches, or installation of a one-foot to two-foot high concrete ring section below the top slab or cone section. This added concrete ring section shall be compatible with the Standard Catch Basin Section and shall accommodate rubber gaskets at the joints.

7-05.3(2)B PIPE CONNECTIONS FOR CATCH BASINS AND INLETS

All new catch basins shall be provided with openings or concrete knockouts for insertion of pipe connections and with a trap for the outlet pipe. The Contractor shall furnish and install new outlet traps for relocated and rebuilt catch basins. When

connections are to be made to existing catch basins with no available hole or knockout, or where a “knockout” of adequate size is not provided, pipe connections shall be accomplished by core drilling, line drilling or wall sawing. All openings shall provide a minimum of 1 inch and a maximum of 2 inches clearance around the circumference of the pipe. Where line drilling is the method used, the method of drilling holes shall prevent overbreakage. After pipes have been placed in position, the opening between pipe and wall of catch basin or inlet shall be grouted as specified in Section 7-05.3(1)N. See Sections 7-08.3(4) and 7-08.3(5) for additional pipe connection requirements.

The outlet trap and the frame and grate shall be located as shown on the Standard Plans and shall be vertically aligned to allow reasonable access for removal and replacement of the outlet trap for vacuum cleaning maintenance operations.

7-05.3(2)C CATCH BASIN GRADE ADJUSTMENT

Catch basin frame and cover grade adjustment shall be in accordance with Section 7-05.3(1)P.

7-05.3(2)D INLET GRADE ADJUSTMENT

The inlet frame may be either cast into a concrete collar or set flange down on a minimum of one row of concrete adjustment blocks and mortared. It shall not, in any case, be mortared to final grade until the final elevation of the pavement, gutter, ditch or sidewalk in which it is to be placed has been established and permission has been given by the Engineer to mortar the frame in place. Location of inlet will be staked by the Engineer. The bottom of the inlet shall be level with the invert of the outlet pipe.

Existing Type 164 inlets shall be adjusted as shown on Standard Plan no. 268 only for pavement resurfacing projects.

7-05.3(2)E RELOCATE EXISTING CATCH BASIN OR INLET

Work required for relocation of existing catch basin or inlet shall include necessary excavation to remove without damage the existing catch basin or inlet, its frame and grate or cover and transporting and installing at the new location. Backfill shall consist of suitable material and compaction shall be in accordance with Section 7-17.3(3). Grade adjustment shall be in accordance with Sections 7-05.3(2)C or 7-05.3(2)D.

The Contractor shall furnish and install new outlet traps (see Section 7-05.3(2)B for outlet trap location requirements).

Existing Type 164 inlets shall be removed and disposed of when a project requires removal and replacement of pavement containing the Type 164 inlet.

7-05.3(2)F REBUILD EXISTING CATCH BASIN

Where noted on the Drawings, the Contractor shall rebuild existing catch basin to accommodate a new frame and grate, or cover, as designated in the Contract. Work required to rebuild catch basin includes excavation, the removal of the existing frame and grate or cover, leveling or adjustment bricks, upper portion of catch basin chamber, and installing a new cone section, leveling or adjustment bricks and new frame and grate or cover. Excavation, backfill, and compaction shall conform to the applicable portions of Section 7-17. Salvage shall be in accordance with Section 2-02.3(7). Grade adjustment shall be in accordance with Sections 7-05.3(2)C.

The Contractor shall furnish and install new outlet traps (see Section 7-05.3(2)B for outlet trap location requirements).

7-05.4 MEASUREMENT

Bid items of Work completed pursuant to the Contract will be measured as provided in Section 1-09.1, Measurement of Quantities, unless otherwise provided for by individual measurement paragraphs herein this Section.

Measurement for “Extra Depth (Type) Manhole” will be by the vertical foot for all depth in excess of 10 feet measured from the invert of the outlet pipe to the top of the casting.

Measurement for Extra Depth for the type of manholes which are built on top of and are fully supported by large diameter pipe, will be by the vertical foot for extra depth in excess of the 10 feet measured from the springline of the “supporting” pipe to the top of the manhole casting.

Measurement for “Extra Depth, Catch Basin” will be by the vertical foot for any 4 foot diameter riser section required over the 4 foot diameter catch basin Standard section shown in Standard Plan no. 240.

7-05.5 PAYMENT

Compensation for the cost necessary to complete the work described in Section 7-05 will be made at the Bid item prices Bid only for the Bid items listed or referenced as follows:

1. **“Manhole (Type)”**, per each.

The Bid item price for “Manhole (Type)” shall include all costs for the work required to furnish and install the manhole complete to finish grade, including excavation, bedding, mortar, non-shrink grout, brick, block, castings, channeling, ladder, steps, connections to pipelines, and backfill with suitable native Material for a manhole depth up to and including 10 feet.

2. **“Extra Depth, (Type) Manhole”**, per vertical foot.

The Bid item price for “Extra Depth, (Type) Manhole” shall include all costs for the work required to construct the portion of a manhole in excess of 10 vertical feet. Payment for extra depth of the A and B types of manhole will be made under the three digit Standard Plan number as 200A, 200B, 201A, 201B, etc.

3. **“Rechannel Manhole”**, per each.

The Bid item price for “Rechannel Manhole” shall include all costs for the work required to complete the manhole rechanneling work as specified in Section 7-05.3(1)T and of core drilling openings for new pipes to the manhole when performed in an existing manhole.

If connecting a new pipe to an existing manhole requires rechanneling of the manhole, the work involved in connecting such pipe to the manhole is incidental to "Rechannel Manhole", per each, and shall be performed as specified in Section 7-05.3(1)T. If the work involves only the cutting of an opening and connecting the pipe without rechanneling, then this work shall be considered included in the Bid item price for installation of the pipe and no other payment will be made therefore.

4. **"Catch Basin, (Type)", per each.**

The Bid item price for "Catch Basin, (Type)" shall include all costs for the work required to furnish and install the catch basin including trap, excavation, backfill, adjustment brick and blocks, mortar, non-shrink grout, plaster, and castings.

5. **"Extra Depth, Catch Basin", per vertical foot.**

The Bid item price for "Extra Depth, Catch Basin" shall include all costs for the work required to construct a catch basin in excess of the standard height as shown in Standard Plan no. 240 when 4 foot diameter riser section(s) are used.

6. **"Inlet, (Type)", per each.**

The Bid item price for "Inlet, (Type)" shall include all costs for the work required to furnish and install the inlet including excavation, brick, block, mortar, and castings.

7. **"Rebuild (Item)", per each.**

The Bid item price for "Rebuild (Item)" shall include all costs for the work required, including the new casting, to completely rebuild the existing item to finished street grade as specified in Sections 7-05.3(1)U or 7-05.3(2)F as applicable.

8. **"Relocate (Item)", per each.**

The Bid item price for "Relocate (Item)" shall include all costs for the work required to relocate the catch basin or inlet including furnishing and installing new outlet trap, excavation and backfill with native Material, adjustment brick and blocks, mortar, non-shrink grout, plaster and castings in accordance with Section 7-05.3(2)E.

9. **Other payment information.**

When Mineral Aggregate Type 17, or other Mineral Aggregate Type designated by the Engineer, is used as backfill, payment shall be per Section 1-09.4.

Payment for "Extra Excavation", will be per Section 7-17.5.

Foundation Material will be paid as "Mineral Aggregate, (Type)", per Section 4-01.5.

When it is determined by the Engineer that the existing foundation is unsuitable and where foundation Material is not specified in the Contract and no Bid item for "Mineral Aggregate, (Type)" of the type required by the Engineer is included in the Bid Form, payment will be made in accordance with Section 1-04.1(2).

Final adjustment of the casting for new construction of manhole, catch basin and inlet shall be considered incidental to and included in the Bid item price for the manhole, catch basin, and inlet.

Where a newly constructed manhole and casting has been completed to finished grade set by the Engineer and is later required to be adjusted to a revised grade by the Engineer, the adjustment will be paid in accordance with Section 1-09.4.

Payment for trench safety system will be paid as specified in Section 7-17.5.

SECTION 7-06 PIPE ANCHORS

7-06.1 DESCRIPTION

Section 7-06 describes work consisting of constructing concrete pipe anchors, prefabricated pipe anchors on tongue and groove concrete pipe and other pipes as designated in accordance with details indicated in the Contract.

7-06.2 MATERIALS

Material shall meet the requirements of the applicable portion of Sections 6-02 and 6-03.

7-06.3 CONSTRUCTION REQUIREMENTS

The construction shall be in accordance with the Contract and the applicable portions of Sections 6-02.3 and 6-03.3.

7-06.4 MEASUREMENT

Bid items of Work completed pursuant to the Contract will be measured as provided in Section 1-09.1, Measurement of Quantities, unless otherwise provided for by individual measurement paragraphs herein this Section.

7-06.5 PAYMENT

Compensation for the cost necessary to complete the work described in Section 7-06 will be made at the Bid item price Bid only for the Bid item listed or referenced as follows:

1. **"Pipe Anchor", per each.**

The Bid item price for "Pipe Anchor" shall include all costs for the work required to furnish and install the pipe anchor.

SECTION 7-07 CLEANING EXISTING DRAINAGE STRUCTURES

7-07.1 DESCRIPTION

Section 7-07 describes work consisting of cleaning and removing all debris and obstructions from existing Culvert pipes, sanitary Sewer pipes, combined Sewer pipes, drains, inlet Structures, manholes, box Culverts, grates, trash racks, or other drainage features in conjunction with the Work within the Project Site.

7-07.2 RESERVED**7-07.3 CONSTRUCTION REQUIREMENTS**

Existing drainage facilities connecting to new work shall be cleaned as a first order of Work to enhance drainage off and through the Project Site. These facilities shall be kept clean up to the Physical Completion Date.

All existing pipes and drainage Structures connecting to new work shall be cleaned by flushing, or by rodding, or by such manner as may be necessary as approved by the Engineer to provide unobstructed drainage. All catch basin sumps, manholes, inlet and outlet Structures, and debris racks shall also be freed of all dirt, rock, and debris.

7-07.4 MEASUREMENT

Work described in Section 7-07 will not be measured for payment.

7-07.5 PAYMENT

All work described in Section 7-07 shall be considered incidental to the various Bid items comprising the Work.

SECTION 7-08 MISCELLANEOUS PIPE CONNECTIONS**7-08.1 DESCRIPTION**

Section 7-08 describes work consisting of excavation, foundation preparation, bedding, backfilling and compacting for the construction of miscellaneous Sewer and drain appurtenances other than those described in Sections 7-01, 7-17 and 7-18.

7-08.2 MATERIALS

Materials shall meet the requirements in Section 9-04 and Section 9-05.

7-08.3 CONSTRUCTION REQUIREMENTS**7-08.3(1) EXCAVATION, FOUNDATION PREPARATION, BEDDING, AND BACKFILL**

Work in trench excavations over 4 feet deep are subject to Trench Safety Systems, Section 7-17.3(1)A7a.

Trench excavation and backfill shall be as specified in Section 7-17.

7-08.3(2) CONNECTIONS TO EXISTING SANITARY SEWERS

When making a connection to an existing sanitary Sewer line or manhole, the Contractor shall excavate and expose the existing facility where shown on the Drawings. In the event there is no existing tee or wye, refer to Section 7-17.3(2)C3 "CUT-IN TEE ON EXISTING PIPE". See Section 7-05.3(1)S for connections to existing manholes.

7-08.3(3) PIPE INSTALLING, JOINTING, AND TESTING

Pipe installing, bedding, jointing, backfilling, and pipe connections shall conform to the applicable requirements of Section 7-17. Testing for acceptance as provided in Section 7-17.3(4) will not be required.

7-08.3(4) CATCH BASIN CONNECTIONS

Catch basin connections are pipe lines connecting outlets of catch basins to a Storm Drain or other facility. Both the alignment and the slope shall be straight with the exception of maintaining clearances in accordance with Section 1-07.17(2). Ninety degree (90°) bends will not be allowed.

No connection shall be made to the catch basin outlet pipe until the excavation around the catch basin has been backfilled and compacted to an elevation which provides support for pipe bedding and the connection pipe. Bedding for catch basin connection pipe shall be Class B bedding.

Connection pipe may be deflected at the joint to avoid obstacles to within the allowable angular deflection recommended by the pipe manufacturer. Such deflection shall be water tight and allow rodding the pipe in a relatively easy manner. Where pipe joints must be deflected, the Contractor shall submit the manufacturer's pipe joint deflection criteria to the Engineer for approval. Under no circumstances will deflection or change of direction be allowed by cutting or trimming the end of the pipe on a bias or an angle. All pipe ends shall be normal angle.

The Contractor shall furnish and install a new outlet trap to the new outlet of the existing catch basin.

See Section 7-05.3(2)B for outlet trap location and catch basin pipe connection requirements.

7-08.3(5) INLET CONNECTIONS

Inlet connections are pipe connections from drainage inlets to catch basins or other approved outlets. Inlet connections shall be installed upgrade from catch basin openings or other originations in straight alignment. Where a straight alignment or a uniform slope is not feasible and curves are necessary, the altered alignment shall be made by deflecting each pipe into a smooth curve. Bends with angles greater than 22.5 degrees shall not be used. Each pipe joint deflection shall not exceed that necessary to maintain a watertight connection as recommended by the pipe manufacturer. The Contractor shall submit the pipe manufacturer's pipe joint deflection criteria. Inlet connection slopes shall be not less than 5% nor more than 50% for any or all portions of the connection with or without deflection.

Pipe connections to a catch basin or other approved outlet shall not be made until the compaction requirements as specified in Section 7-08.3(4) have been met and the work has been approved by the Engineer. Bedding for inlet connection pipe shall be Class B bedding.

See Section 7-05.3(2)B for inlet pipe connection requirements.

7-08.3(6) DROP CONNECTIONS

Inside and outside drop connections, used in conjunction with different types of manholes to allow for abrupt drop in elevation of the inflow, shall be constructed as shown on Standard Plan nos. 233a and 233b, and at locations indicated on the Drawings. The invert elevation of the outside drop connection will be specified on the Drawings. The crown elevation of the inside drop connection shall match the crown elevation of the manhole outlet pipe.

7-08.3(7) VERTICAL CONNECTION

Vertical connections shall be constructed in accordance with Standard Plan no. 234, unless the Contract specifies otherwise.

7-08.4 MEASUREMENT

Bid items of Work completed pursuant to the Contract will be measured as provided in Section 1-09.1, Measurement of Quantities, unless otherwise provided for by individual measurement paragraphs herein this Section.

Measurement for "Pipe, Catch Basin Connection, (Material), (Class), (Size)" will be by the linear foot of pipe installed between the tee or wye in the receiving Sewer and the inside face of the catch basin.

Measurement for "Pipe, Inlet Connection (Material) (Class), (Size)" will be by the linear foot of pipe installed between the inside face of the inlet, and the inside face of the catch basin.

Measurement for "Drop Connection, Outside, (Size)" will be by the vertical foot from the invert of the bend connection at the manhole, to the invert at the upstream end of the tee as shown on Standard Plan no. 233a.

Measurement for "Drop Connection, Inside, (Size)" will be by the vertical foot from surface grade to the crown elevation at the end of the pipe elbow in the manhole as shown on Standard Plan no. 233b.

Measurement for "Vertical Connection (Size)" will be from surface grade to the crown elevation of the connecting pipe.

Measurement for "Pipe, Catch Basin Connection, (Material), (Class), (Size)" when the pipe is an outlet pipe from a flow control Structure will be measured from the inside wall of the flow control Structure (see Section 7-16.4).

7-08.5 PAYMENT

Compensation for the cost necessary to complete the work described in Section 7-08 will be made at the Bid item prices Bid only for the Bid items listed or referenced as follows:

1. "Pipe, Catch Basin Connection, (Material), (Class), (Size)", per linear foot.
2. "Pipe, Inlet Connection, (Material), (Class), (Size)", per linear foot.

The Bid item prices for "Pipe, Catch Basin Connection, (Material), (Class), (Size)" and for "Pipe, Inlet Connection, (Material), (Class), (Size)" shall include all costs for the work required to furnish and install the pipe, including connections to catch basins or inlets, excavation, backfill, and compaction.

3. "Drop Connection, (Type), (Size)", per vertical foot.

The Bid item price for "Drop Connection, (Size)" shall include all costs for the work required to furnish and install the complete inside or outside drop connection as shown on Standard Plan nos. 233a and 233b.

4. "Vertical Connection, (Size)", per vertical foot.

The Bid item price for "Vertical Connection, (Size)" shall include all costs for the work necessary to furnish and install the vertical connection as shown on Standard Plan no. 234.

5. **Other payment information.**

The cost for furnishing and installing new outlet trap when installing catch basin connection pipe to existing catch basin shall be included in the Bid item price for "Pipe, Catch Basin Connection, (Material), (Class), (Size)".

Payment for bedding will be in accordance with Section 7-17.5.

Payment for trench safety system will be as specified in Section 7-17.5.

Payment for clay dam, and for CDF bedding and backfill, will be as specified in Section 7-17.5.

SECTION 7-09 PIPE AND FITTINGS FOR WATER MAINS**7-09.1 DESCRIPTION**

Section 7-09 describes work included under Sections 7-09 through 7-15 consisting of the construction of water distribution and transmission pipelines and appurtenances for both temporary and permanent installations.

7-09.2 MATERIALS

Materials shall meet the requirements of Section 9-30.

Polyvinyl chloride, polyethylene, polybutylene, and asbestos cement as pipe material, and the use of elastomers (such as those used in jointing gaskets and packing glands), shall not be used as or incorporated in Water Main to convey potable water.

The Contractor shall only install new and unused Materials suitable and approved for potable water supply.

It is not intended that Materials listed herein for potable Water Mains, fittings, and appurtenances are to be necessarily considered equally suitable or generally interchangeable for all applications. It is intended that "or equal" or "or

approved equal" or any Material substitution will not be allowed unless the Contract so specifies (see Section 1-06.1). Those Materials suitable for the project will be specified in the Contract.

The pipe manufacturer shall test all pipe and fittings as required by these Standard Specifications and by the applicable recognized standards of national organizations referenced (see Section 1-06.2). The pipe manufacturer shall submit to the Engineer two copies of all test results including a Manufacturer's Certificate of Compliance that Material to be delivered to, and intended for incorporating in, the project is represented by the samples tested and that such delivered Materials meet or exceed the specified requirements. No pipe shall be delivered until test results and Manufacturer's Certificate(s) of Compliance are approved by the Engineer.

The Engineer shall have free access to all testing and records pertaining to Material to be delivered to the project Site. The Engineer may elect to be present at any or all Material testing operations.

7-09.3 CONSTRUCTION REQUIREMENTS

The Contractor shall not operate any valve on an existing Water Main.

Trench excavation, bedding, and backfill for Water Mains is described in Section 7-10.

Pipe installation for Water Mains and fittings is described in Section 7-11.

Valves for Water Mains is described in Section 7-12.

Hydrants are described in Section 7-14.

Water service connections are described in Section 7-15.

7-09.4 RESERVED

7-09.5 RESERVED

SECTION 7-10 TRENCH EXCAVATION, BEDDING AND BACKFILL FOR WATER MAINS

7-10.1 DESCRIPTION

Section 7-10 describes work consisting of excavating, bedding, and backfilling for Water Mains and the construction of distribution and transmission Water Mains and appurtenances for both temporary and permanent installation.

Water Mains shall be constructed at the locations shown on the Drawings.

Where rough grading is required at the beginning of Work, such grading, including excavation and embankment construction, shall conform to the requirements of Section 2-03. Rough grading shall be completed before excavating for the Water Main trench.

Borrow and disposal sites shall conform to the requirements of Section 2-03.3(13).

7-10.2 MATERIALS

Materials specified as "Mineral Aggregate, (Type)" shall be in accordance with Section 9-03.

7-10.3 CONSTRUCTION REQUIREMENTS

7-10.3(1) GENERAL

See Section 7-17.3(1)A7a regarding trench excavation safety requirements. See Section 7-10.3(7) for additional trench excavation requirements when the Work involves construction of potable Water Mains and related Structures and appurtenances.

See Sections 1-07.23 and 1-10 regarding construction operations and traffic.

Clear access shall be provided and maintained to fire hydrants, water valves, water meters, water vaults, and related water Structures at all times unless the Contract specifies otherwise.

Clearance shall be left to allow storm water to flow freely in gutters, other conduits, and natural watercourses.

Water distribution main, water transmission main, water services, and fire hydrant and connection pipe shall be installed at least five (5) feet clear of any tree measured edge to edge.

7-10.3(2) UNGRADED STREETS

On ungraded streets, when grading is not called for in the Contract, the depth of trench excavation shall be as indicated on the Drawings and as staked by the Engineer.

Where the Drawings show pipe is to be installed above existing ground surface, an embankment fill shall be made and compacted to conform with the section shown on the Drawings, and the Water Main trench shall be excavated therein. That portion of the embankment below the bottom of the pipe shall be compacted with rollers or mechanical compactors under controlled moisture conditions as required under Method B of Section 2-03.3(14)D.

7-10.3(3) CLEARING AND GRUBBING IN UNGRADED STREETS

See Section 2-01.

7-10.3(4) REMOVAL OF EXISTING STREET IMPROVEMENTS

See Section 2-02.

7-10.3(5) GRADE AND ALIGNMENT**7-10.3(5)A GENERAL**

Trenches for pipe shall be opened in accordance with the lines and grades indicated on the Drawings, and to a depth that maintains the minimum required depth of cover unless indicated otherwise in the Contract (see Section 7-10.3(5)C).

On improved streets, the grade and alignment shall be taken from established points set by the Engineer.

7-10.3(5)B VERIFICATION OF LOCATION

After marking underground facilities (see Sections 1-07.17(1) and 7-10.3(6)) and prior to any pavement cutting or removal or excavation for pipe installation, the Contractor shall verify, in the presence of the Engineer, the locations of existing Water Mains. The Contractor shall arrange to establish their depths at points where connections are to be made. After excavation, the Contractor shall verify the dimensions, type, and condition of the exposed Water Main. Should a condition be discovered which materially differs from indicated in the Contract, the Contractor shall immediately notify the Engineer. When necessary, the profile shall be adjusted as directed by the Engineer so that abrupt changes in grade and alignment of Water Main and connection are prevented.

7-10.3(5)C MINIMUM DEPTH OF COVER

The depth of trenching for distribution Water Mains shall give a minimum depth of cover as indicated on Standard Plan no. 030. The depth of trenching for transmission Water Main shall give the minimum depth of cover as indicated in the Contract. Where profile of Water Main and ground surface is shown on the Drawings, the Water Main shall be installed to the elevation shown on the Drawings, regardless of depth of cover for distribution Water Main indicated on Standard Plan no. 030. Deeper excavation may be required due to localized breaks in grade or due to installing the new distribution Water Main under existing Culverts or other underground facilities where necessary. Excavation shall be to such depth that the cover over the valve operating nut shall be a minimum 1 foot.

7-10.3(6) EXISTING UTILITIES AND TEMPORARY SERVICE CONNECTION

See Section 1-07.17 for utilities and similar facilities and for Water Main clearance requirements.

When utility services occupy the same space as the new Water Main, the Contractor shall do all necessary excavation to fully expose such services. The Contractor shall protect said services and work around them during excavating and pipe installation operations. The Contractor shall be responsible for all damage to the services. When existing services are damaged due to Contractor operations, the Contractor shall immediately notify the Engineer and arrange for timely repair or replacement. In the event of conflict with other underground facilities, the Contractor shall immediately notify the Engineer. Mainline Sewers and storm drains shall not be damaged, removed or relocated. Water Main pipe shall be installed to clear these utilities (see Section 1-07.17(2)).

Existing Water Mains and fittings encountered during trench excavation and indicated on the Drawings to be removed (or if removal is required by the Engineer) shall be removed, and disposed of (Section 1-07.3) or salvaged by the Contractor (Section 2-02).

All ends of abandoned Water Main shall be plugged in accordance with Section 2-02.3(5). Pipe 12 inch and larger shall be abandoned and filled in accordance with Section 2-02.3(5).

In conducting the Work, the existence of and how to address private water service utilities and appurtenances is addressed in Section 1-07.17(1). When it is necessary to provide temporary water supply connections due to conflict between existing privately owned water service laterals and appurtenances and with the new Water Main, it shall be the responsibility of the Contractor to provide temporary services.

Permanent replacement of temporary water services with new water services shall be as directed by the Engineer, and require inspection and approval by SPU Water Customer Service. The Contractor shall give a minimum 2 Working Days advance notice by contacting 206-684-5800. Also see Section 7-15.

Should the Contractor damage or disrupt private water services or appurtenances, the Contractor shall immediately notify the Engineer of any such damage or disruption, shall begin repairs immediately as directed by the Engineer, and shall work continuously until the condition is accepted.

7-10.3(7) TRENCH EXCAVATION**7-10.3(7)A GENERAL**

Sidewalk, pavement, appurtenant Structure, adjacent improvement and underground installation adjacent to and beyond the trench shall not be undermined or disturbed.

The Contractor shall perform excavation to the depth, line, and grade indicated on the Drawings. All excavations shall be made by open cut methods and shall include excavation for pipe bedding as applicable (see Standard Plan no. 350).

The length of trench excavation in advance of pipe installation operations shall be kept to a minimum, and in no case shall it exceed 500 feet for transmission pipeline, and 200 feet for distribution Water Main.

The maximum trench width in the Right of Way shall not exceed the neatline trench width as shown on Standard Plan no. 350.

Outside the Right Of Way and in unimproved areas, trench width above the top of pipe may at the Contractor's option exceed the maximum trench width indicated on Standard Plan no. 350 by sloping or benching. However, all requirements for excavating, handling and disposing of excavated material, and placing and compacting additional suitable backfill, outside of Standard Plan no. 350 neatline trench limits shall be at the sole expense of the Contractor.

When Water Main invert or other elevations are indicated on the Drawings, the Contractor shall excavate to that depth plus any additional excavation as necessary to accommodate the Contract specified class of bedding. When no invert or other elevation is indicated in the Contract, the Contractor shall excavate to a depth, including additional excavation as necessary for the class of bedding when specified in the Contract, to provide the minimum cover as indicated in Standard Plan no. 030. When Water Main elevations are specified in the Contract, excavation below that depth shall be backfilled with suitable native material and shall be compacted to 90% as specified in Section 2-03.3(14)E at the Contractor's sole expense. The Contractor shall provide overexcavation for bells such that pipe barrels and bells along the Water Main are uniformly supported full length.

Grading and other excavations nearby shall be controlled to prevent surface water from flowing into the excavations. All material excavated from trenches and piled adjacent to the trench shall be piled and maintained so that the toe of the slope is at least 2 feet from the edge of the trench. This material shall be piled to cause a minimum of inconvenience to public travel, and provision shall be made for merging traffic where necessary. Clear access shall be provided to all fire hydrants, water valves, and meters. Surface drainage and runoff along gutters to storm drain facilities and along natural watercourses shall not be blocked. See Section 1-07 for other requirements. Suitable excavated material for reuse as backfill shall be stockpiled in an acceptable manner and shall be protected from becoming unsuitable. Unsuitable material, or suitable material in excess of project needs, shall be disposed of by the Contractor (see Section 2-01.2).

Excavation for valve chambers and other Water Main Structures shall be sufficient to provide a minimum of 12 inches between their exterior surfaces and the sides of the excavation.

Prior to installation of bedding, when required in the Contract, and installation of pipe, the trench bottom shall be brought to grade as indicated for the type of bedding specified and if disturbed, compacted to 90% as specified in Section 2-03.3(14)E to provide a foundation Capable of supporting the pipe full length in its proper position.

All ledgerrock, boulders, stones, and any object larger than 3 inch in any dimension shall be removed within 6 inches in any direction from the pipe. The maximum size of aggregate within 6 inch of the pipe shall not exceed 1 inch per foot of pipe diameter and in no case shall exceed 3 inch.

The Contractor shall remove any protective system in such a manner as to not disturb bedding or backfill. Where bedding or backfill is disturbed, the Contractor shall reconsolidate the material as specified.

7-10.3(7)B EXTRA EXCAVATION

The requirements of Section 7-17.3(1)A2 shall apply. All references to Standard Plan nos. 284 and 285 shall mean Standard Plan no. 350.

7-10.3(7)C DEWATERING

In addition to the requirements of Section 7-17.3(1)A3, during the installation of Water Main, jointing, coating, cathodic and electrolysis protection, and the placement of bedding and trench backfill, excavations shall be kept free of water. All references to Standard Plan nos. 284 and 285 shall mean Standard Plan no. 350.

At all times, all non-potable water and any other debris shall be prevented from entering Water Main. At the end of each day's work on any portion of Water Main, the Contractor shall provide a temporary seal ensuring nothing can enter the Water Main or any new construction for the Water Main.

Also see Section 7-11.3(1) for additional requirements.

7-10.3(7)D UNEXPECTED OBJECTS

The requirements of Section 7-17.3(1)A4 shall apply. All references to Standard Plan nos. 284 and 285 shall mean Standard Plan no. 350.

7-10.3(7)E TRENCH EXCAVATION IN SOLID ROCK

See Section 7-17.3(1)A5. All references to Standard Plan nos. 284 and 285 shall mean Standard Plan no. 350.

7-10.3(7)F SURPLUS MATERIAL

The requirements of Section 7-17.3(1)A6 shall apply. All references to Standard Plan nos. 284 and 285 shall mean Standard Plan no. 350.

7-10.3(7)G PROTECTIVE SYSTEMS

7-10.3(7)G1 TRENCH SAFETY SYSTEMS

The Contractor shall comply with the requirements of Section 7-17.3(1)A7a. All references to Standard Plan nos. 284 and 285 shall mean Standard Plan no. 350.

7-10.3(7)G2 SUPPORT SYSTEM

The requirements of Section 7-17.3(1)A7b shall apply. All references to Standard Plan nos. 284 and 285 shall mean Standard Plan no. 350.

7-10.3(8) MATERIAL FROM TRENCH EXCAVATION

7-10.3(8)A REMOVAL AND REPLACEMENT OF UNSUITABLE MATERIAL

See Sections 7-10.3(7)B and 7-10.3(7)F.

7-10.3(8)B SURPLUS MATERIALS

See Section 7-10.3(7)F.

7-10.3(9) BEDDING THE PIPE**7-10.3(9)A RIGID PIPE****7-10.3(9)A1 GENERAL**

All distribution Water Main shall have either Class D bedding, or Class B bedding with either of Mineral Aggregates Type 6 or Type 7. All transmission Water Main shall have Class B bedding with Mineral Aggregate Type 9. See Standard Plan no. 350. Allowance for excavation to accommodate pipe bells and any fittings shall be made to provide uniform support along the pipe barrel.

Care shall be taken to prevent any damage to the pipe, to any protective coating, and to any electrolysis monitoring system.

7-10.3(9)A2 BEDDING FOR POLYETHYLENE ENCASED, MULTI-LAYERED POLYETHYLENE TAPE COATING, THERMOPLASTIC POWDER COATED, OR SPECIAL COATED PIPE

Class B bedding Material for specially protected or coated pipe shall be Mineral Aggregate either Type 6 or Type 7 in accordance with Section 9-03. Class B bedding consisting of Mineral Aggregate Type 6 or Type 7 shall be compacted by tamping.

Bedding of specially protected pipe shall be conducted at all times in such manner as to prevent damage to the protective coating or wrap.

Placing of Class B bedding around wrapped or coated or specially protected pipe shall be done in a manner acceptable to the Engineer. Any damage to the special protection or coating or wrap shall be repaired by the Contractor at the Contractor's sole expense in a manner acceptable to the Engineer.

7-10.3(9)B FLEXIBLE PIPE**7-10.3(9)B1 BEDDING FOR FLEXIBLE PIPE**

Bedding for flexible pipe, when flexible pipe is permitted for use, shall be Class B with Mineral Aggregate Type 22 placed in lifts as shown on Standard Plan no. 350. Care shall be used in installing flexible pipe to prevent vertical pipe deflection.

The first bedding lift thickness shall be placed, spread and compacted across the width and length of the trench bottom at the required grade to support the pipe. Allowance shall be made for pipe bell and any other fitting. Pipe is then installed and the next lift of bedding Material carefully placed and compacted evenly along both sides of the pipe up to the crown, being careful not to displace the pipe from its set line and grade. Once the bedding is completed to the crown of the pipe, and the pipe shows no visible misalignment, the final bedding lift over the pipe shall be placed.

7-10.3(10) BACKFILLING TRENCHES

Prior to backfilling, all form lumber and debris shall be removed from the trench. The protective system used by the Contractor shall be systematically removed to allow for acceptable backfilling. Where Class D bedding is required, backfill up to 6 inches over the top and both sides of the pipe shall be evenly and carefully placed, but not until all material, such as rock not Capable of passing a 3 inch sieve or similar objectionable material, Capable of damaging the pipe or its coating or its electrolysis monitoring system have been removed from the backfill Material.

In backfilling the trench, the Contractor shall take all necessary precautions to protect the pipe from any damage or shifting. The Contractor shall backfill to a uniform depth of 1 foot above ductile iron pipe before starting compaction, and to a uniform depth of 2 feet above concrete pipe before starting compaction.

During all phases of the backfilling operations and testing as outlined herein, the Contractor shall protect the pipe installation, provide for the maintenance of traffic as may be necessary, and provide for the safety of property and persons.

See Section 7-10.3(8)A for unsuitable material and replacement Material requirements.

The Contractor shall protect suitable excavated material from becoming contaminated or excessively moist.

Where it is required that a blanket of selected Material or bank run gravel be placed on top of the native backfill, the backfill shall be placed to such elevation as shown on the Drawings, and shall be leveled to provide for a uniform thickness of the selected Material. Compaction is required, and it shall be performed prior to placing the selected Material.

The Contractor shall use suitable native excavated Material for trench backfill unless notified by the Engineer that the native Material is unsuitable. The Engineer will examine excavated native Material at the time of excavation to determine its suitability for use as backfill (see Section 2-03.3(10)). Native Material will be considered suitable for trench backfill if it is:

1. Capable of attaining the degree of compaction specified in Section 7-17.3(3)B;
2. Within reasonable tolerance of optimum moisture content; and
3. Reasonably free of organic material, clay, frozen lumps, rocks or pavement chunks more than 6 inches in maximum dimension, or other deleterious matter.

Unsuitable backfill Material shall be removed from the site, disposed of per Section 1-07.3, and replaced with selected Material, Mineral Aggregate Type 17 or such other imported Material as designated by the Engineer.

Pipe trenches shall be backfilled as soon as possible after the pipe installation. See Section 7-10.3(7)A for length of trench limitations. Backfilling of trenches in the vicinity of catch basins, manholes, or other appurtenances will not be permitted until new cement in the masonry has become thoroughly hardened.

Walking on the pipe shall not be allowed until at least 1 foot of cover has been placed upon the pipe.

7-10.3(11) COMPACTION OF BACKFILL

The Contractor shall place the initial lift of loose backfill to a uniform depth of 2 feet above the crown of concrete pipe and to a uniform depth of 1 foot above the crown of ductile iron pipe before starting compaction. Trench backfill shall continue in uniform lifts not exceeding 1 foot loose thickness and be compacted by impact type mechanical tampers approved by the Engineer. Water settling will not be permitted. Degree of compaction shall meet Section 2-03.3(14)E requirements as follows:

1. Improved areas such as street and sidewalk areas, compaction shall be 95% of maximum dry density.
2. Unimproved areas or landscape areas shall be compacted to 90% of maximum dry density.

The procedure and equipment to be used for backfill compaction shall be demonstrated on a test section of Water Main backfill at a location designated by the Engineer. The Contractor shall excavate test pits as directed by the Engineer for the purpose of testing the backfill compaction. The Contractor shall make these arrangements prior to backfilling.

If the required compaction density has not been obtained, the Contractor shall remove the backfill from the trench and recompact using an improved technique, heavier compaction equipment or more passes. This process shall be repeated until the Contractor has established a procedure that provides the required degree of compaction. The Contractor will then be permitted to proceed with backfilling and compacting the remainder of the Water Main under the approved compaction procedure.

In the event routine field densities taken during the course of construction show the specified compaction is not being obtained because of changes in soil types or for any other reason, the Contractor will be required to reestablish the compaction procedure. In no case will excavation and pipe installation operations be allowed to proceed until the specified compaction is attained.

7-10.4 MEASUREMENT

Bid items of Work completed pursuant to the Contract will be measured as provided in Section 1-09.1, Measurement of Quantities, unless otherwise provided for by individual measurement paragraphs herein this Section.

Measurement for "Solid Rock Excavation" will be in accordance with Section 2-03.4.

Measurement for "Mineral Aggregate, (Type)" will be in accordance with Section 4-01.4.

Measurement for "Extra Excavation" will be by the cubic yard of in-place material actually removed beyond the neatlines indicated on Standard Plan no. 350.

Measurement for "Bedding, (Class), (Size) Pipe" for Water Main will be in accordance with Section 7-17.4.

Measurement for "Safety Systems in Trench Excavation, Minimum Bid = \$0.40 per Square Foot" will be in accordance with Section 7-17.4.

7-10.5 PAYMENT

Compensation for the cost necessary to complete the work described in Section 7-10 will be made at the Bid item prices Bid only for the Bid items listed or referenced as follows:

Imported Material when ordered in lieu of native backfill material by the Engineer will be paid for as "Mineral Aggregate, (Type)" in accordance with Section 4-01.5.

Payment for "Extra Excavation" and for "Bedding, (Class), (Size) Pipe" shall be in accordance with Section 7-17.5.

Payment for "Solid Rock Excavation" shall be in accordance with Section 2-03.5.

Foundation Material, when required in the Contract, will be paid for as "Mineral Aggregate, (Type)" in accordance with Section 4-01.5.

If no Bid item is in the Bid Form for Mineral Aggregate of the Type designated by the Engineer, or for "Solid Rock Excavation" or for "Extra Excavation", the Contractor shall perform the work as directed by the Engineer, and payment will be made in accordance with Section 1-04.1(2).

No separate payment will be made for excavating the trench, placing and compacting the native backfill material, hauling and placing excess suitable native material elsewhere on the project, or hauling and disposing of excess materials offsite whether suitable or unsuitable. These costs shall be considered as being included in the Bid item prices for each class, size, and type of pipe in accordance with Section 7-11.5.

Payment for "Safety Systems in Trench Excavation, Minimum Bid = \$0.40 per Square Foot" will be in accordance with Section 7-17.5.

Where unexpected objects, such as stumps, railroad ties, etc. are encountered in the trench excavation, and such unexpected objects cause the Contractor delays or require extra work or equipment for its removal, payment will be in accordance with Section 1-09.4. When the presence of these objects is indicated in the Contract, and is not included as a Bid item in the Bid Form, the removal of these objects shall be considered included in the Bid item prices of the applicable Bid items and no separate or additional payment will be made.

No separate payment will be made for furnishing and installing sand cushion and protection of existing utilities and services. These items shall all be included in the Bid item prices of the Water Main Bid items.

All costs for plugging ends of abandoned Water Main shall be included in the Bid item prices of the applicable Bid items.

Payment for bedding for Water Main will be in accordance with Section 7-17.5.

All costs incurred by the Contractor in providing temporary water service, when deemed necessary by the Engineer, shall be considered included in the Bid item prices for the applicable Bid items and at no additional or separate cost to the Owner.

In the event the Contractor elects to use pipe bedding or Mineral Aggregate of any Type below the pipe to facilitate dry construction, all costs for furnishing and placing these materials shall be borne by the Contractor.

Any material that becomes unusable due to the Contractor's failure to take adequate measures to provide protection from moisture shall be replaced at the Contractor's expense with Mineral Aggregate Type 17 or such other Material as the Engineer will accept.

All costs in connection with excavating test pits and from standby time during field density tests shall be considered as incidental to the backfill.

All costs for removing or salvaging existing Water Mains and fittings as specified in Section 7-10.3(6) shall be considered incidental to the various Bid items comprising the Contract.

The cost for cutting and reconnecting water services by the SPU Water Operations as requested by the Contractor for his work as specified in Section 7-10.3(6) will be charged to the Contractor. Also see Section 7-15.5.

The hauling away of surplus material from the excavation to other areas of the project or disposing of the material offsite shall be considered as incidental to the Bid item price of pipe installed.

SECTION 7-11 PIPE INSTALLATION FOR WATER MAINS

7-11.1 DESCRIPTION

Section 7-11 describes work consisting of installing Water Main pipe in accordance with the manufacturer's printed specifications and instructions and with the AWWA standards for installing the type of pipe proposed.

Pipe sections shall be joined in such a manner as not to damage the lining or coating. The method of pulling or jacking the pipe home shall allow for both vertical and horizontal movement of the pipe for protection of the gasket.

Water Main installation shall not proceed until line and grade hubs have been set and measurements for connection fittings have been made in accordance with Section 7-10.3(5).

Clearances shall be maintained between Water Mains and other utilities per Section 1-07.17(2).

7-11.2 MATERIAL

7-11.2(1) GENERAL

Material shall meet the requirements of Section 9-30 and Section 9-04.

Pipe and Pipe Coatings	9-30.1
Fittings	9-30.2
Valves, Valve Boxes, and Valve Chambers	9-30.3
Hydrants	9-30.5
Service Connections and Service Pipe or Tubing	9-30.6
Bedding, Foundation Material and Gravel	9-30.7
Joint Bond Cable	9-30.10
Thermite Weld Materials	9-30.11
Electrolysis Test Station	9-30.12
Turbine Meters (sizes 2" – 12")	9-30.13
Locating Wire	9-30.14
Coating for Bolts and Shackle Rods	9-30.15
Backflow Prevention Assemblies	9-30.16

7-11.2(2) PRE-INSTALLATION TASTE AND ODOR TESTING

All Water Main manufactured of any material and all Water Main lining material shall either:

1. satisfactorily pass an Engineer conducted SPU Taste And Odor Rating Test, or
2. be a product of a material person pre-approved by the Engineer in accordance with SPU's Taste And Odor Rating Test Program.

The Contractor shall allow for Taste And Odor Rating Testing as follows:

Material	Time for Testing and Reporting Results
Water Main	Up To 30 Working Days ¹
Water Main Lining Material	Up to 30 Working Days ¹

Note 1 This time can be reduced to as little as 10 Working Days if:

- 1) a test on a section of pipe, either with or without lining Material, can be done as a bench scale test and not by a full scale test with a pipe manifold, and
- 2) a retest is not required.

Time for testing and reporting results is based on the day the Material is received by the Engineer to the day the results are available to the Engineer.

Water Main pipe Material will be sampled for testing at the rate of one for each lot of 100 or fewer, for each diameter size pipe.

Water Main lining Material will be sampled for testing.

No Taste And Odor Rating Test will be required for service connection pipe.

Materialmen with Taste And Odor Rating Test Program pre-approved Water Main and Water Main lining material can be obtained by contacting 206-684-7834.

Materialmen can obtain cost information on the Taste And Odor Rating Test Program pre-approval process for Water Main and Water Main lining material by contacting 206-684-7834.

7-11.2(3) POST INSTALLATION TASTE AND ODOR RATING TESTS

The Engineer reserves the right to perform post installation Taste And Odor Rating Testing on any portion of the Work prior to or after connection to existing Water Main. Such retesting may be performed as part of bacteriological sampling and testing during flushing and testing (see Sections 7-11.3(12)L and 7-11.3(12)M), and may include sampling and testing of mortar and lining materials. Post-installation Taste and Odor Rating Testing shall require a minimum 48 hours contact time in the Water Main assembly under test. Depending on the extent of the testing required, results will be made available in not more than 15 Working Days.

If results of additional Taste and Odor Tasting Rating Testing are determined unacceptable, the Contractor shall be prepared to make timely correction as determined by the Engineer.

Failure of the system or portion of the system to pass the Taste and Odor Rating Test will result in the rejection of all of the new Water Main under test.

7-11.3 CONSTRUCTION REQUIREMENTS

7-11.3(1) DEWATERING OF TRENCH

In addition to the requirements of Section 7-10.3(7)C, where water is encountered in the trench, the water shall be removed during pipe installation operations and trench dewatering shall be maintained until the ends of the pipe are sealed and provisions are made to prevent floating of the pipe. Trench water or other deleterious materials shall not be allowed to enter the pipe at any time.

7-11.3(2) HANDLING OF PIPE

7-11.3(2)A GENERAL

All types of pipe shall be handled in a manner that prevents damage to the pipe, and pipe lining or coating. Pipe and fittings shall be loaded and unloaded using hoists and slings in a manner to avoid shock or damage, and under no circumstances shall they be dropped, skidded, or rolled against other pipe. Damaged pipe will be rejected, and the Contractor shall immediately place all damaged pipe apart from the undamaged and shall remove the damaged pipe from the Project Site within 24 hours.

Threaded pipe ends shall be protected by couplings or other means until the pipe is installed.

The pipe and fittings shall be inspected for defects.

Ductile iron and cast iron pipe, while suspended above grade, shall be rung with a light hammer to detect cracks. Dirt or other foreign material shall be prevented from entering the pipe or pipe joint during handling or installing operations, and any pipe or fitting that has been installed with dirt or foreign material in it shall be removed, cleaned, and reinstalled. A clean whisk broom shall be used for this purpose and for brushing to remove foreign matter prior to joining of pipe ends. At times when pipe installation is not in progress, the open ends of the pipe shall be closed by a watertight plug or by other means approved by the Engineer to ensure cleanliness inside the pipe.

Pipe shall be stacked in such a manner as to prevent damage to the pipe, to prevent dirt and debris from entering the pipe, and to prevent any movement of the pipe. The bottom tiers of the stack shall be kept off the ground on timbers, rails or other similar supports. Pipe on succeeding tiers shall be alternated by bell and plain end. Timbers 4-inch X 4-inch in size shall be placed between tiers and chocks shall be placed at each end to prevent movement. Each size of pipe shall be stacked separately.

7-11.3(2)B HANDLING SPECIAL COATED PIPE

Handling and shipping of enameled or multilayered polyethylene tape coated or thermoplastic powder coated ductile iron pipe while being transported and in the field shall be in accordance with AWWA C214, and as specified herein.

Pipe, at all times, shall be handled with equipment such as stout wide canvas slings and wide padded skids designed to prevent damage to the coating. Bare cables, chains, hooks, metal bars or narrow skids shall not be permitted to come in contact with the lining or coating. When shipped by rail, all pipe shall be carefully loaded on properly padded saddles not less than 12 inches in width. Pipe sections shall be separated so that they do not bear against each other and the whole load shall be securely fastened together and to the cars to prevent movement in transit.

In truck shipments, the pipe shall be supported in wide cradles of suitable padded timbers hollowed out on the supporting surface to fit the curvature of pipe. All chains, cables or other equipment used for fastening the load shall be carefully padded.

The Engineer will inspect the pipe and coating after delivery to the Project Site prior to installation by the Contractor. The Contractor shall allow inspection of the coating on the underside of the pipe while suspended from the sling, before the pipe is lowered into the trench.

Pipe stored along the trench side shall be supported by padded wooden timbers placed under the pipe to hold the pipe off the ground, or by other acceptable means not damaging to the pipe and pipe coating.

Repair of multi-layered polyethylene tape coating shall be in accordance with AWWA C214 and Section 7-11.3(6)C. Repair of thermoplastic powder coated pipe shall be per manufacturer's written instructions. The Contractor shall submit at least 3 Working Days in advance the manufacturer's recommendations for thermoplastic coating repair.

7-11.3(3) CUTTING PIPE

Whenever it becomes necessary to cut a length of pipe, the cut shall be made by abrasive saw or by a special pipe cutter. All pipe ends shall be square with the longitudinal axis of the pipe. The outside of slip joint pipes shall be beveled and smoothed so that good connections can be made without damage to the gasket. Threads shall be cleanly cut. Torch cutting of ductile iron pipe will not be allowed.

Restrained joint pipe shall be cut in accordance with the pipe manufacturer's recommendations. The Contractor shall submit at least 3 Working Days in advance, the pipe manufacturer's recommendation for cutting restrained joint pipe including a Manufacturer's Certificate of Compliance stating the cutting process does not adversely impact the pipe material or integrity of the joint.

7-11.3(4) INSTALLING PIPE ON CURVES

On long radius curves, either horizontal or vertical, pipe may be installed with standard pipe by deflecting the joints. If the pipe is shown curved on the Drawings and no special fittings are shown, the Contractor can assume that the curves can be made by deflecting the joints with standard lengths of pipe. If shorter lengths are required, the Drawings will indicate maximum lengths that can be used. The amount of deflection at each pipe joint when pipe is installed on a horizontal or vertical curve shall not exceed the manufacturer's printed recommended deflections. The Contractor shall submit to the Engineer the pipe manufacturer's joint deflection recommendations prior to pipe installation indicating deflections are within allowable AWWA specification tolerances.

Where field conditions require deflection or curves not anticipated on the Drawings, the Engineer will determine the methods to be used.

When rubber gasketed pipe is installed on a curve, the pipe shall be jointed in a straight alignment and then deflected to the curved alignment. Trenches shall be made wider on curves for this purpose.

Maximum deflections at pipe joints and installation radius for various pipe lengths shall conform to the manufacturer's and AWWA specifications for the given type of pipe.

Where pipe installation on curves requires the use of special fittings, concrete blocking shall be used per Section 7-11.3(13).

Where restrained joint pipe is installed on a curve, the Contractor shall submit the pipe manufacturer's recommendations to the Engineer for approval at least 3 Working Days in advance.

7-11.3(5) CLEANING AND ASSEMBLING JOINTS

All parts of the pipe ends, couplings, fittings, and appurtenances shall be cleaned to remove oil, grit, or other foreign matter from the joint. Care shall be taken to keep the joint from contacting the ground.

Pipe not furnished with a depth mark shall be marked before assembly to ensure visual observation of the Work.

7-11.3(6) INSTALLING AND JOINTING PIPE

7-11.3(6)A INSTALLING AND JOINTING - DUCTILE IRON PIPE AND APPURTENANCES

The installation of ductile iron pipe and appurtenances shall be in accordance with AWWA C600.

Except where restrained joint systems are required, mechanical or slip joints may be used.

7-11.3(6)B INSTALLING AND JOINTING POLYETHYLENE ENCASED (FILM WRAPPED) PIPE

Pipe with polyethylene (film wrap) encasement shall be installed in accordance with AWWA C105. The method used for encasing the pipe shall be approved by the Engineer. All damage to the polyethylene encasement shall be repaired at the Contractor's sole expense. Bedding and backfill shall be in accordance with Sections 7-10.3(9), 7-10.3(10), and 7-10.3(11).

7-11.3(6)C INSTALLING AND JOINTING MULTI-LAYERED POLYETHYLENE TAPE COATED PIPE

Pipe shall be hoisted from the trench side into the trench by means of a wide canvas or leather sling. Use of chains, cables, tongs or other equipment likely to cause damage to the lining or to the coating of the pipe will not be permitted. Dragging or skidding the pipe will not be permitted. The Contractor shall allow inspection of the coating on the underside of the pipe while suspended from the sling. Any damage to the coating shall be repaired to a condition meeting the specified requirements before the pipe is lowered into the trench. Bedding and backfill shall be in accordance with Sections 7-10.3(9)A2, 7-10.3(10), and 7-10.3(11).

At all times during construction of the Water Main, the Contractor shall use every precaution to prevent damage to the protective coating on the pipe. No metal tools or heavy objects shall be unnecessarily permitted to come in contact with the finished coating. Workers will be permitted to walk on the coating only when necessary, in which case they shall wear shoes with rubber or composition soles and heels. This shall apply to all surfaces whether bare, primed or coated. Any damage to the protective coating from any cause, prior to final acceptance of the Water Main, shall be repaired as directed by the Engineer and at the Contractor's expense.

Cutbacks on the spigot end shall be 6 inches or less and shall be made with a cutting device that is guided from the end of the pipe to ensure a straight, uniform cutback. No cutback shall be made on the bell end of the pipe.

Following the application of the outerwrap, the coating shall be electrically tested for holidays with a pulse tape holiday detector. The detector voltage range for this coating is 7000 to 9800 volts. The testing shall conform to NACE RP-02-74.

All holidays detected in the field shall be repaired by removing the outerwrap and primary coating from the damaged area, cleaning the exposed surfaces thoroughly and applying a suitable primer and tape to the exposed area as specified by the manufacturer. If required by the Engineer, the repaired area shall be outerwrapped after patching.

If the outerwrap is damaged and a holiday is not found in this area, the damaged outerwrap area shall be repaired by applying a patch as recommended by the manufacturer and approved by the Engineer.

If the outerwrap is damaged and a holiday is found, the damaged outerwrap shall be removed, taking care not to damage the inner coating. Before new outerwrap is placed, a holiday detector shall be applied to the exposed innerwrap to determine if it has been damaged during removal of the outerwrap. The outerwrap shall be installed as recommended by the manufacturer and approved by the Engineer.

After electrical bonds are installed and tested, the entire pipe joint and electrical bond strap shall be protected with a heat shrink joint sleeve. See Section 9-30.1(6)E Heat Shrink Joint Sleeve.

7-11.3(6)D INSTALLING RESTRAINED JOINT PIPE

The restrained joint Water Main to be installed shall be fully extended by pulling on the joint after the installation of the pipe segments as recommended by the manufacturer of the restrained joint pipe. When this newly installed Water Main is charged, bending or buckling of newly installed restrained joint Water Main will not be accepted. The Contractor shall submit the restrained joint manufacturer's recommendations to the Engineer at least 5 Working Days prior to pipe installation.

Restrained joint Water Main shall be installed as located on the Drawings. This work shall include all hardware and as necessary to perform this work.

7-11.3(7) INSTALLING STEEL PIPE

7-11.3(7)A THREADED STEEL PIPE LESS THAN 4 INCHES IN DIAMETER

Steel pipe in sizes up to and including 3-1/2 inches shall be connected with malleable iron screwed couplings. Couplings shall be galvanized. Unions or flanges shall be used at all equipment and valves. Cut ends shall be reamed and threads cleanly cut. Exposed threads, after jointing, shall be brush-coated with an asphalt varnish, Royston Roskote Mastic R28 or approved equal.

7-11.3(7)B COUPLED PIPE 4 INCHES IN DIAMETER AND LARGER

Steel pipe 4-inch and larger, for use in underground services, shall be coupled as specified in the Contract.

Any welding of steel pipe shall be in accordance with AWWA C206.

Bell and spigot joints shall be thoroughly cleaned before assembly, and a lubricant suitable for potable water meeting the approval of NSF shall be brushed on the inside of the bell just prior to assembly.

7-11.3(7)C STEEL CASING PIPE

All joints shall be welded by operators who have been qualified by tests as prescribed by the AWS in Standard Qualifications Procedure to perform the type of work required. The quality of welding shall conform to the current edition AWS D1.1 Structural Welding Code, Section 3, Workmanship.

Contractor shall submit to the Engineer for approval, an outline of the proposed construction procedure together with a listing of the equipment. In the event that the pipe is damaged during the installation and the defects cannot be corrected to a condition meeting the required Specifications, the Contractor shall be required to remove and replace the pipe.

7-11.3(7)D STEEL CASING PIPE FOR UNDERGROUND AND TRENCHLESS CONSTRUCTION

7-11.3(7)D1 GENERAL

Where shown on the Drawings, the Contractor shall install steel casing pipe for the Water Main by an underground or trenchless construction method other than directional drilling as specified in Section 7-17.3(2)J, and if by directional drilling then in accordance with Section 7-22.

All joints shall be welded by operators who have been qualified by tests as prescribed by the AWS in "Standard Qualifications Procedure" and are certified to perform the type of work required. The quality of welding shall conform to the current edition AWS D1.1 Structural Welding Code, Section 3, Workmanship.

The Contractor shall submit to the Engineer for approval, an outline of the proposed construction procedure together with a listing of the equipment and Supplies for the work.

7-11.3(7)D2 SEALS AND SPACERS BETWEEN CASING AND WATER MAIN

Casing end seals shall meet the requirements of Section 9-30.2(15)A, shall completely seal the annular space at each end of the casing pipe, and shall be installed in accordance with the manufacturer's instruction.

Casing spacers shall electrically isolate the outer casing pipe from the inserted Water Main. The spacers (also known as "casing insulators", "crossing insulators", and "casing isolators") shall meet the requirements of Section 9-30.2(15)B. There shall be a minimum of two spacers per length of pipe, and the spacing between any two (2) spacers shall not exceed 10 feet. For 4 inch through 12 inch diameter pipe, each spacer shall have at least four (4) runners. For 14 inch through 36 inch diameter pipe, each spacer shall have at least six (6) runners. At least 2 runners shall be located on the upper half of the spacer for all diameter Water Main. At least 2 runners shall be located on the lower half of the spacer for 4 inch through 12 inch diameter Water Main, and at least 4 runners shall be located on the lower half of the spacer for 14 inch through 36 inch diameter Water Main. Actual locations of runners on the spacer shall be as recommended by the manufacturer. Casing spacers shall first be installed on the Water Main and then the Water Main inserted in the casing pipe in accordance with the manufacturer's instructions.

The Contractor shall submit the spacer and end seal manufacturer's catalog cuts and installation instruction to the Engineer at least 5 Working Days in advance of this work.

7-11.3(8) FIELD APPLIED COATINGS**7-11.3(8)A WAX TAPE COATING**

Wax tape coating (see Section 9-30.1(6)F) shall be field applied to Water Main including pipe, fittings, valves, couplings, bolts, flanges, shackle rods, other appurtenance, and as indicated in the Contract.

Preparation for wax tape coating shall be one of the following, as applicable:

- 1) On Water Main without a coating, the surfaces shall be cleaned with wire brush, cleaning products, duct tape "dust and particle pickers", and similar means and Supplies to remove all rust, dirt, oil, and other deleterious material. The Contractor shall be prepared to employ sandblasting methods for stubborn rust and other deleterious coating removal. The surface shall be dry, have no loose particles of any kind, and shall be in a prepared condition as recommended by the wax tape Supplier.
- 2) On Water Main with a coating, the surfaces shall be cleaned with Supplies and means that do not injure or harm the existing coating; however, produce a prepared surface as recommended by the wax tape Supplier. Water Main with existing coating and type of coating will be identified in the Contract.

Coverage by wax tape coating shall be "complete" meaning full contact with all Water Main Material and no voids. Where voids, or gaps, or irregular surfaces and transitions in the Water Main exist, joint filler, compatible with the wax tape coating product as recommended by the wax tape Supplier, shall be applied "complete". Outerwrapping without being complete is unacceptable.

Coverage shall extend to a minimum 1 pipe diameter length beyond the wax tape limits indicated in the Contract.

Coverage thickness shall be a minimum 70 mil.

Wax tape application on prepared surfaces typically include:

1. initial coating with a petrolatum primer,
2. wrapping with wax tape, and
3. outer wrapping with fiberglass mesh.

All products in the wax tape application shall be compatible with each other and with the Water Main prepared surfaces. The Supplier may recommend an alternate component(s) to provide an acceptable protective coating.

Submittal: The Contractor shall submit to the Engineer for approval at least 10 Working Days in advance, the Supplies and method proposed for preparing the Water Main, the wax tape coating system and how applied, any alternate component(s) and the reason(s) for, Supplier recommendations with sufficient detail indicating an acceptable finished product, and Supplier contact information.

7-11.3(9) CONNECTIONS**7-11.3(9)A CONNECTIONS TO EXISTING WATER MAINS**

The Contractor shall not operate any valve on an existing Water Main.

The SPU Water Operations will make all connections to charged Water Mains and will operate all valves to accomplish shutdowns and subsequent reactivation. Draining of existing Water Mains will be done by Water Operations staff. See Section 7-10.3(5) for verification of existing Water Main grade and alignment. The Contractor shall match the grade and alignment of the new Water Main to the existing Water Main. The excavation shall be sufficiently large to accommodate connection work as approved by the Engineer.

Connection points shall be verified in accordance with Section 7-10.3(5)B.

The Contractor shall provide the Engineer 2 Working Days advance notice for scheduling inspections for approval of Water Main installations for connection. Within 2 Working Days after the inspection, the Contractor will be provided with written approval or with a list of items to be corrected. Items to be corrected will be reinspected. The notification requirement and reinspection response times are the same as the initial inspection.

After all tests, flushing, and disinfection have been successfully completed and the installed Water Main and appurtenances, including hydrants and valves, have been approved by the Engineer, it shall be the Contractor's responsibility to request the Engineer to schedule the shutdown(s) and connection(s) prior to surface restorations.

Approval is contingent on the Water Main and appurtenances being completely installed and tested per Contract but does not require completion of street, sidewalk and planting strip restorations. Water Main and appurtenances include all pipe, fittings, all blocking except temporary blocking, all hydrants, hydrant pads, blowoff assemblies, valves, flowmeters, chambers, corrosion protection, and coating systems.

Newly installed Water Main shall be pressure tested and found acceptable in accordance with Section 7-11.3(11) Hydrostatic Pressure Test; shall be flushed, disinfected, tested, and found acceptable in accordance with Section 7-11.3(12) Flushing and Disinfection of Water Mains before making any connection; and when required shall be found acceptable for Taste and Odor Rating Testing before and/or after making any connection as specified in Section 7-11.2(3).

After all tests, flushing, and disinfection have been successfully completed and the installed Water Main and appurtenances, including hydrants and valves, have been approved by the Engineer, it shall be the Contractor's responsibility to request the Engineer to schedule the shutdown(s) and connection(s) prior to surface restorations. In general, the Contractor's request for shutdown(s) and connection(s) shall be submitted to the Engineer at least 5 Working Days in advance of the desired date of the connection. However, the Contractor is encouraged to communicate and coordinate with the Engineer as early in the project as possible regarding the scheduling of these connections as SPU Water Operations' shutting down and starting up portions of the water system will take into consideration:

1. Size of Water Main and total system impacts,
2. Coordination with fire and other needs,
3. End user needs and coordination, and
4. SPU Water Operation's workforce availability.

The Contractor's scheduling of connections requires the Engineer's approval. The excavation for the connection shall be completed, shored and dewatered, and all required materials and equipment shall be available at the time of shutdown. Notifications of the scheduled shutdown will be made by SPU Customer Service / Inspection Services personnel to the affected consumers a minimum of 2 Working Days in advance of the scheduled shutdown. Connections must be made within 2 weeks of bacterial acceptance or the pipe must be retested.

The SPU will furnish connection fittings when specified in the Contract; otherwise, the Contractor shall furnish and install the connection fitting (see Standard Plan nos. 300a, 300b, and 300c). In addition, prior to and after connection of the new Water Main, SPU Water Operations will:

- a. Deactivate Water Main;
- b. Cut, remove, and dispose of pipe sections as necessary to install the new Materials;
- c. Dewater existing pipe, as required, to perform SPU Water Operations connections;
- d. Swab all connecting pipe and fittings with chlorine solution (5-6% Cl₂); and
- e. Reactivate and flush the Water Main.

All fittings and other Materials and equipment not specifically called out in the Contract as being furnished by SPU Water Operations, required to complete the connection shall be furnished by the Contractor. The Contractor shall coat, wrap and joint bond the connection to conform with the requirements of the new Water Main.

The Contractor shall make all necessary excavation, protective measures, and backfill, and provide any equipment and operators required to move and lower the component parts of the connection into position. All temporary and permanent blocking shall be done by the Contractor.

In addition to those connections shown on the Drawings, segments of a new Water Main may be placed in service prior to completion of the entire Water Main. All connections between the charged and uncharged segments of the new Water Main will be done by SPU Water Operations.

Locations of connections between segments of new Water Main are dependent on Contractor's operations and therefore are not shown. All Materials for such connections shall be furnished by the Contractor.

7-11.3(9)B MAINTAINING SERVICE

Where existing services are to be transferred from old to new Water Mains, the Contractor shall plan and coordinate the Work with that of SPU Water Operations so that service is resumed with the least possible inconvenience to customers.

To supply customers with water during the construction of a project, where any section of pipe has passed the required hydrostatic and bacteriological tests, SPU Water Operations reserves the right to tap corporation stops into a section of a new Water Main and install corporation stops and service connections at such locations as SPU Water Operations deems necessary, at no expense to the Contractor. The attaching of any such service connections by the SPU Water Operation's shall not be construed by the Contractor as any acceptance by the Owner of any part of the Work required under the Contract.

7-11.3(9)C WATER SERVICE CONNECTIONS

See Section 7-15.

7-11.3(9)C1 INSULATED COUPLINGS AND FLANGE KITS

Insulated couplings and flange kits shall be installed to electrically isolate the Water Main from other Structures. Insulated joints shall be located at the locations indicated on the Drawings.

The Contractor shall carefully align and install insulating couplings and flange kits according to the manufacturers recommendations to avoid damaging insulating Materials. Coat all exposed surfaces of insulating flange, including fasteners,

with petroleum-impregnated wax tape as specified in AWWA C217. The Contractor shall submit to the Engineer for review, the manufacturer's installation recommendations at least 3 Working Days prior to use.

7-11.3(9)D TEMPORARY WATER MAINS AND SERVICES

When called for in the Contract, SPU Water Operation's will install and maintain temporary Water Mains and services in such a manner as to provide constant adequate water supply to consumers and to avoid impeding traffic and access to abutting properties.

The Contractor's critical path schedule shall allow adequate time for SPU Water Operations to install these facilities. A minimum of 2 weeks advance written notice shall be provided to the Engineer for scheduling of the temporary Water Main and service work.

SPU Water Operations will make all required excavation, backfill, and compaction as well as furnishing the necessary equipment and pipe for temporary Water Mains.

All temporary Water Mains will be disinfected, flushed, and sampled for bacteriological testing by the SPU Customer Service / Inspection Services. If found acceptable, the temporary Water Mains will be placed in service.

7-11.3(10) LOCATING WIRE

Locating wire shall be installed 6 inches directly above the centerline of all non-metallic pipe, except that the locating wire shall be bonded by exothermic welds to all metallic fittings, valves and valve boxes to form an electrically continuous system.

7-11.3(11) HYDROSTATIC PRESSURE TEST

7-11.3(11)A GENERAL

All Water Mains and appurtenances shall be hydrostatically pressure tested. Once the new Water Main has passed the hydrostatic pressure test, the Water Main shall be flushed, disinfected, and bacteriologically sampled in accordance with Section 7-11.3(12), and may be required to pass additional post-installation Taste and Odor Taste Rating Testing in accordance with Section 7-11.2(3).

All labor, equipment, pumps, gauges, plugs, saddles, corporation stops, miscellaneous hose and piping, a 1/4 inch F.I.P.T. connection for pressure recorder, and as necessary for performing the test, shall be furnished and operated by the Contractor.

Pressure recorders and charts used to record the tests will be furnished and operated only by the Engineer.

The Contractor, prior to notifying the Engineer to witness and record the pressure test, shall have set up beforehand and successfully performed the pressure test to make certain that the pipe is in acceptable condition. The Contractor shall then notify the Engineer at least 2 Working Days before recording and conducting the test.

The Contractor shall furnish and install temporary blocking as required for pressure testing. Upon successful testing, temporary blocking shall be removed.

To protect existing Water Mains from contamination by backflow of test water during filling operations, a WSDOH approved reduced pressure principle backflow prevention assembly shall be temporarily installed between the test and supply Water Main. See Section 1-07.28 item 7D for notification requirements regarding BPA inspection. A current BPA performance test report shall be provided by the Contractor and shall be on the Project Site for the assembly being used. Prior to hydrostatic testing, the temporary backflow protection shall be installed and the Water Main under test isolated from the supply Water Main.

7-11.3(11)A1 TEST PRESSURE FOR FIELD TESTING WATER MAIN PIPE

Field hydrostatic testing of various diameter ductile iron Water Main pipes and appurtenances shall be as indicated in the following table:

Diameter Pipe (inches)	4	6	8	10	12	16 and larger
Test Pressure (psi)	300	300	300	300	300	250

Test pressure for pipe other than ductile iron will be indicated in the Contract.

The indicated test pressure shall be at the lowest elevation of the section of Water Main being tested. All air in the pipe shall be vented prior to test.

The hydrostatic test pressure shall be maintained until the Engineer has determined that the section of pipe, valves, and fittings are watertight. If there are no visible leaks and the test pressure is maintained without pumping for 15 minutes with a pressure drop of less than 15 psi, the Water Main will be accepted as a water tight installation. When testing short (less than 18 feet) lengths of Water Main pipe or when testing hydrant pipe, maintaining the test pressure without pumping for 5 minutes with less than 5 psi drop in pressure will be considered evidence of an acceptable test.

Sections to be tested shall be limited to 1,500 feet or less. The Engineer may require that the first section of pipe, not less than 1,000 feet in length, installed by each of the Contractor's crews, be tested in order to qualify the crew and the Material. Pipe installation shall not be continued more than an additional 1,000 feet until the first section has been tested successfully.

Hydrostatic tests shall be performed on every completed section of Water Main between valves. The pressure differential across closed valves shall not exceed the rated operating pressure of the valve.

All tests shall be made with the hydrant auxiliary gate valves open and with pressure exerted against the closed hydrant inlet valve. After the test has been completed, gate valves shall be tested by closing each one in turn and relieving the pressure beyond. This test of the gate valve will be acceptable if no immediate loss of pressure is registered on the gauge when the valve is being checked. The Contractor shall verify that the pressure differential across the valve does not exceed the rated test pressure of the valve.

Any visible leakage detected shall be corrected by the Contractor regardless of the allowable leakage specified above. Should the tested section fail to meet the pressure test as specified, the defects shall be located and repaired and the Water Main retested at the Contractor's sole expense.

Defective materials or workmanship discovered as a result of a hydrostatic field test shall be replaced and remedied by the Contractor in accordance with Section 1-05.7. Whenever it is necessary to replace defective Material or correct the workmanship, the hydrostatic test shall be rerun until an acceptable test is obtained.

7-11.3(11)B TESTING EXTENSIONS FROM EXISTING WATER MAINS

When an existing Water Main is extended over 18 feet, the section of new pipe installed to the existing Water Main will be made by SPU Water Operations with pretested, pre-disinfected pipe, and no hydrostatic test will be required. SPU Customer Service / Inspection Service shall be notified for approval at least 3 Working Days in advance if predisinfected pipe is proposed for installation. When the required hydrostatic tests are conducted in the new Water Main section beyond the installed new valve in the closed position, the normal pressure of the existing Water Main may be present against the other side of the new valve.

Where the distance between the end of an existing Water Main pipe extension to the new valve is more than 18 feet, the connection of the new pipe to existing pipe shall not be made until after hydrostatic tests have been made to the required pressure in both directions against the new valve. This shall be accomplished by a temporary cap or plug installed on the end of the new pipe, beyond the new valve, as close as possible to the existing pipe for testing purposes. Where a new valve is not part of the Work, the Contractor shall notify the Engineer at least 10 Working Days in advance to coordinate other arrangements for hydrostatic testing.

The short length of pipe between the temporary cap or plug end with the new valve in the closed position, with no hydrostatic pressure active on the opposite side of the valve, shall be subjected to the required test pressure. The same test shall be made against the other side of the new valve when that section of pipe is tested with no hydrostatic pressure active in the short section of pipe toward the existing Water Main pipe. The final connection to the existing Water Main shall be made by the SPU Water Operations with pretested, pre-chlorinated pipe, and no hydrostatic test will be required.

7-11.3(11)C TESTING SECTION WITH HYDRANTS INSTALLED

When hydrants are included with the section of Water Main pipe to be tested, the testing shall be conducted in three separate tests as follows:

Test No. 1	Water Main gate valves and hydrant auxiliary gate valves closed, with the hydrant operating stem valves and hose ports wide open.
Test No. 2	Water Main gate valves and the hydrant operating the stem valves tightly closed but the hydrant auxiliary gate valves and hose ports wide open.
Test No. 3	Each hydrant shall be tested to 200 psi with the hydrant auxiliary gate valve and hose ports closed and the hydrant operating stem valve wide open. Twenty-five pounds per square inch shall be in the supply Water Main beyond the hydrant auxiliary gate valve when testing a hydrant singly.

7-11.3(11)D TESTING HYDRANTS INSTALLED ON EXISTING WATER MAINS

For hydrants installed and connected to an existing Water Main, the hydrant connection including hydrant tee, connection pipe, and auxiliary gate valves, shall be installed with pretested Materials.

Before the hydrant connection is made to the existing Water Main, the hydrant installation shall be subjected to the hydrostatic Test No. 3 as specified in Section 7-11.3(11)C. Following an acceptable hydrostatic test, hydrants installed and connected to an existing Water Main shall have a bacteriological sample obtained and tested for acceptable results before connection the Water Main.

7-11.3(12) FLUSHING AND DISINFECTION OF WATER MAINS

7-11.3(12)A GENERAL

Before being placed in service, all newly installed pipe, valves, hydrants, and appurtenances shall be flushed, disinfected, kept clean, and will be sampled for acceptable bacteriological analysis. Additional Taste and Odor Rating Testing may be required (see Section 7-11.2(3)).

Newly installed Water Main will have a sample taken from each and every 500 foot interval, and at each end. For each hydrant lateral over 18 feet in length, a sample will be taken at the hydrant end. Hoses for sampling will not be allowed. On new Water Main without hydrant, temporary sampling taps shall be provided, and then removed and plugged after the Engineer notifies the Contractor of acceptable bacteriological results. Hydrant used for sampling shall be fitted with a sampling tap acceptable to the Engineer.

The Contractor shall coordinate with the Engineer for the location of sampling taps. All bacteriological analysis will be performed by the SPU Water Quality Laboratory. Written notice of the results of sample analysis will be returned to the Contractor 2 Working Days after the sampling. Analysis of any sample indicating unacceptable results shall require the remedy specified in Section 7-11.3(12)M. Analysis of any sample indicating acceptable results shall require the new Water

Main be connected to existing Water Main within 14 calendar Days of the Date of written notice. Failure to make the connection within this time frame shall require additional disinfection, flushing, and additional sampling and testing for acceptable results. The Engineer reserves the right to perform additional bacteriological sampling and testing at any time.

7-11.3(12)B PRE-DISINFECTION FLUSHING

Sections of pipe smaller than 24-inch diameter to be disinfected by methods other than that found in Section 7-11.3(12)D, METHOD 1, shall first be flushed to remove any solid or contaminated material. If METHOD 1 is used, the 2-1/2 fps flushing shall be done after disinfection is complete (see Section 7-11.3(12)L, Final Flushing and Testing). If no hydrant is installed at the end of the new pipe, the Contractor shall provide a tap large enough to develop a velocity of at least 2.5 feet per second in the pipe. Flushing period shall be at least 5 minutes for every 150 feet of new pipe but in no case less than 30 minutes. One 2-1/2 inch hydrant opening will, under normal pressure of 40 psi, provide this velocity in pipe sizes up to and including 12 inches. For pipe sizes exceeding 12-inch diameter, flushing taps size requirements are:

REQUIRED FLOW AND OPENING TO FLUSH WATER MAINS		
Pipe Diameter (inches)	Flow Required to Produce 2-1/2 feet per second (fps) Velocity in Water Main (gpm)	Number - Size (inch) of Taps Required for a 2-1/2 fps Flush
14	1200	3 - 2", or 1 - 3"
16	1600	4 - 2", or 1 - 4"
20	2500	6 - 2", or 3 - 3", or 2 - 4"
24	3600	4 - 3", or 2 - 4", or 1 - 6"
30	5625	4 - 4", or 2 - 6", or 1 - 8"
36	8100	2 - 6", or 1 - 8"
42	11025	3 - 6", or 1 - 10"
48	14400	4 - 6", or 1 - 12"

Taps required for chlorination, flushing or temporary or permanent release of air shall be furnished and installed by the Contractor and are incidental to the construction of Water Mains. When a hose bib faucet is installed for bacteriological sampling, it shall be located upstream from the flushing point. Taps on existing Water Mains required for chlorination or flushing will be furnished and installed by SPU's Water Operations Division.

As an alternative to 2-1/2 fps flushing, sections of pipe 24 inches or larger diameter may be prepared for disinfection by mechanical cleaning methods approved by the Engineer.

The Contractor shall be responsible for disposing of treated water flushed from the Water Mains in a manner acceptable to state and local authorities. The water shall be neutralized before disposal into any natural drainage channel. The Contractor shall maintain an air gap equal to twice the discharge pipe/hose diameter (but not less than 12 inches) between the discharge outlet and the overflow rim of the receiving waters.

7-11.3(12)C REQUIRED CONTACT TIME

Before being placed into service, all newly installed pipe shall be disinfected so that a chlorine residual of not less than 10 mg/L remains in the water after the retention period. Treated water shall be retained in the pipe at least 24 hours. If the water temperature is less than 41°F (5°C), the water shall remain in the pipe for at least 48 hours. After the retention period, chlorine residual shall be tested at all extremities of the pipe and shall measure at least 10 mg/L. If a measurement of less than 10 mg/L is obtained repeat disinfection is required.

7-11.3(12)D FORM OF APPLIED CHLORINE

Chlorine shall be applied by one of three methods to give a dosage of not less than 25 mg/l of available chlorine:

METHOD - 1 Dry Calcium Hypochlorite

As each length of pipe is installed, sufficient high test calcium hypochlorite (65 -70% chlorine) shall be placed in the pipe to yield a dosage of not less than 25 mg/l available chlorine, calculated on the volume of the water to be contained in the pipe and appurtenances. This method may only be used if the pipes and appurtenances are kept clean and dry during construction.

The number of ounces of 65% test calcium hypochlorite required for a 20 foot length of pipe equals $0.004216d^2$ in which "d" is the pipe diameter in inches.

METHOD - 2 100% Gas Chlorine

A chlorine gas-water mixture shall be applied by means of a solution-feed chlorinating device. Chlorinating devices for feeding solutions of the chlorine gas shall provide means for preventing the backflow of water into the chlorine supply. See Section 1-07.28 item 7D regarding BPA notification and testing requirements.

METHOD - 3 Sodium Hypochlorite

Sodium Hypochlorite, commercial grade (12.5% Cl₂) or in the form of liquid household bleach (5 - 6% Cl₂), may be substituted for the chlorine gas-water mixture. This liquid chlorine compound may be used full strength or diluted with water and injected into the Water Main with fill water in correct proportion to produce a mixture of at least 25 mg/l Cl₂.

7-11.3(12)E CHLORINE DOSAGE

The amounts of chlorine (Cl_2) required to give 25 mg/l for 100-foot lengths of various diameters of pipe are:

AMOUNTS OF CHLORINE REQUIRED FOR 25 MG/L DOSAGE				
Pipe Size (inch)	Volume of Water per 100 ft Length (gallons)	Cl_2 100% (lbs)	Household Bleach 5-1/4% Cl_2 (gallons)	Commercial Bleach 12-1/2% Cl_2 (gallons)
4	65.3	.014	.03	.013
6	146.5	.031	.07	.03
8	261.0	.054	.13	.053
10	408.0	.085	.2	.08
12	588.7	.121	.3	.12
14	799.6	.167	.4	.16
16	1044.4	.22	.5	.21
20	1631.9	.34	.8	.33
24	2349.9	.49	1.1	.47
30	3671.7	.77	1.8	.75
36	5287.3	1.1	2.5	1.1
42	7196.6	1.5	3.5	1.44
48	9399.0	2.0	4.6	1.6

7-11.3(12)F POINT OF APPLICATION FOR LIQUID/GAS DISINFECTION

The preferred point of application of the chlorinating agent is at the beginning of the Water Main extension or any valved section of it and through a corporation stop inserted in the horizontal axis of the pipe. The water injector for delivering the chlorine-bearing water into the pipe shall be supplied from a tap on the pressure side of the gate valve controlling the flow into the Water Main extension. Alternate points of application may be used when approved by the Engineer.

7-11.3(12)G BACKFLOW PREVENTION REQUIREMENT

To prevent contaminated water from the new Water Main from entering the existing distribution system, a disinfected WSDOH approved reduced pressure backflow assembly shall be used on the line supplying the water. An approved reduced pressure backflow assembly is sufficient backflow protection only for filling and flushing of the new Water Main. During the hydrostatic pressure test, the temporary connection between the new Water Main and the existing distribution system shall be removed. See Section 1-07.28 item 7D for backflow prevention assembly notification and testing requirements.

7-11.3(12)H RATE OF APPLICATION

Water from the existing distribution system, or other approved supply source, shall be controlled for very slow flow into the newly installed Water Main during chlorine application. The rate of chlorine gas-water mixture or dry gas feed shall be in such proportion to the rate of water entering the newly installed pipe that the dosage applied to the water is at least 25 mg/l.

Sodium hypochlorite, commercial grade (12.5% Cl_2) or in the form of liquid household bleach (5-6% Cl_2), may be substituted for the chlorine gas-water mixture. This liquid chlorine compound may be used full strength or diluted with water and injected into the Water Main in correct proportion to the fill water so that dosage applied to the water is at least 25 mg/l.

7-11.3(12)I RESERVED**7-11.3(12)J RESERVED****7-11.3(12)K DISINFECTION OF CONNECTIONS TO EXISTING WATER SYSTEMS**

All connections shall be disinfected per the requirements of AWWA C651 section titled "Disinfection Procedures When Cutting into or Repairing Existing Main". All pipe and fittings shall be swabbed or sprayed with a chlorine solution at least as strong as liquid household bleach (5-6% Cl_2).

7-11.3(12)L FINAL FLUSHING AND TESTING

Following chlorination, all treated water shall be flushed from the pipe until the replacement water treated throughout its lengths shows an absence of chlorine. If chlorine is normally used in the source of supply, tests shall show a residual not in excess of that carried in the system.

Where dry calcium hypochlorite has been used for disinfection, flushing velocity shall be at least 2.5 feet per second in the Water Main. Flushing period shall be at least 5 minutes for every 150 feet of new Water Main but in no case less than 30 minutes.

See Section 7-11.3(12)A for bacteriological sampling and testing, and see Section 7-11.2(3) for post installation Taste and Odor Rating Testing when required by the Engineer.

All hydrants on the new Water Main shall be flushed to remove excess chlorine from the hydrant and hydrant branch.

7-11.3(12)M REPETITION OF FLUSHING AND TESTING

Based on any unacceptable bacteriological sample results (see Section 7-11.3(12)A), the new Water Main or hydrant connection over 18 feet shall be either flushed and re-sampled, or re-disinfected, flushed and re-sampled. These procedures shall be repeated by the Contractor until acceptable bacteriological sample results are obtained.

7-11.3(13) CONCRETE THRUST BLOCKING

Concrete thrust blocking, as indicated on Standard Plan nos. 330a through 331b, shall be placed at bends, tees, deadends, and crosses as located on the Drawings. Blocking shall be Class 5 (1-1/2) (see Section 5-05.3) concrete mix poured in place.

Concrete blocking shall bear against solid undisturbed earth at the sides and bottom of the trench excavation and shall be shaped so as not to obstruct access to the joints of the pipe or fittings.

The Contractor shall provide the Engineer at least 1 Working Day advance notice for inspection and approval of all concrete blocking prior to backfilling. Unacceptable concrete blocking shall be replaced at the Contractor's expense.

7-11.3(14) BLOWOFF ASSEMBLIES

Water Main blowoff assemblies shall be constructed as shown on the Drawings or Standard Plan nos. 340a and 340b. A standard meter box shall be installed in non-traffic bearing areas; a Type 361 Frame and Cover shall be used for all other installations subject to vehicular traffic. Care shall be taken in locating the meter box or frame and cover such that it is not in any water course or in any other location subject to drainage or sewerage contamination. Tops shall be set to conform to finished grade. Backfilling and compaction shall conform with Sections 7-10.3(10) and 7-10.3(11).

Drilling and tapping into the Water Main shall be performed by the Contractor except in the event of installation on a charged (in-use) Water Main, in which case SPU Water Operations will make the connection.

7-11.3(15) ELECTROLYSIS MONITORING SYSTEM FOR DUCTILE IRON PIPE**7-11.3(15)A GENERAL**

Where called out on the Drawings, the Water Main Contractor furnishing the pipe shall comply with the following:

1. **Install Electrical Continuity Bonds:** The Contractor shall furnish and install electrical joint bonds, as specified herein, at all mechanical coupling non-insulated flange joints and all rubber gasket joints. The Contractor shall take special precautions to avoid disturbing existing bonds, electrical cables, and wires for test stations and other cathodic protection equipment connected to, or installed near the Water Main.
2. **Install Electrolysis Test Stations:** The Contractor shall furnish and install the Electrolysis Test Stations where shown, and as detailed on the Drawings.

7-11.3(15)B ELECTRICAL JOINT BONDS FOR ALL DUCTILE IRON PIPES AND FITTINGS**7-11.3(15)B1 GENERAL**

Each length of ductile iron pipe in the Water Main, and each hydrant run, shall be electrically bonded together, and each mechanical joint shall be bonded to the pipe as shown on the Drawings. The Contractor shall make adhesion tests of all bonds and bonded joints in the presence of the Engineer. Any bonded joint which fails to meet the adhesion test shall be rebonded until an acceptable test is obtained. Bonding cable shall be as specified in Section 9-30.10.

Details of mechanical joint bonding shall be as shown in Standard Plan no. 362.

7-11.3(15)B2 JOINT BOND CABLE CONNECTIONS FOR DUCTILE IRON PIPE

Prior to making any bond connection to metal, a 2 inch x 2 inch section of coating materials shall be removed from the pipe surface to make the connection. Paint, primer, and coating material shall be removed from the pipe surface with clean rags and solvent prior to preparing the metal surface. The metal surface shall be cleaned to white metal by sandblasting, grinding, or filing prior to welding the conductor. Resin-base grinding disks shall not be used. Ceramic base disks are acceptable. Joint bonding cable shall be welded to the pipe or fitting by the exothermic process with a copper sleeve fitted over the exposed conductor. Only sufficient insulation shall be removed from the bonding cable to allow placing of the welding mdd. After the weld is completed it shall be tested in accordance with Section 7-11.3(15)D.

Defective welds shall be removed and replaced.

Exposed metal surfaces around the thermite weld including the end of the copper conductor, and the weld itself, shall be covered with coating material as shown on the Drawing or in accordance with Section 9-30.11(3).

The Contractor shall provide the Engineer sufficient advance notice so that all connections to pipe obtain inspection and approval prior to covering. Bond connections not receiving Engineer inspection prior to cover or backfill will be rejected.

7-11.3(15)B3 RESERVED**7-11.3(15)B4 TESTING ELECTROLYSIS TEST STATION**

The Contractor shall provide the Engineer written notice at least 72 hours in advance, to perform a functional test of the electrolysis test station before backfilling.

7-11.3(15)C ELECTROLYSIS TEST STATION**7-11.3(15)C1 GENERAL**

Electrolysis Test Stations shall be installed as indicated on Standard Plan no. 360.

7-11.3(15)C2 ZINC REFERENCE ELECTRODES

Place reference electrode within the Water Main trench excavation 6" horizontally from the Water Main at or just below the springline. An exception is where Water Main crosses any other metallic pipe in which the electrode is to be placed between the Water Main and the other pipe. Reference electrodes shall be backfilled with suitable Material. Terminate wires in the test stations.

7-11.3(15)C3 TEST STATION

The test station shall consist of a molded test station box installed inside a conventional cast iron water meter box for non-traffic areas or inside a Type 230 frame and cover for traffic areas. The cover shall have the letters "WATER" cast into it.

7-11.3(15)C4 TEST WIRES

Wire location, connections to pipe, size, insulation color, and crimp-on wire connectors shall be as shown on the Standard Plan no. 363.

7-11.3(15)D THERMITE WELD CONNECTIONS

Each bond connection shall be insulated thoroughly with a Royston Handy Cap or approved equal. The cap shall completely cover the cleaned area and provide insulation of the bond connection from the soil environment. The cap shall be attached by use of a bonding cement or primer and shall contain an elastomeric Material under a plastic dome. The elastomeric Material shall mold completely around the bond wire and weld area. The cap shall be a minimum of 4 inches x 4 inches x 125 mils thick. Caps are not required when the connection is covered by heat shrink joint wrapping.

7-11.3(15)D1 TESTING EXOTHERMIC WELD CONNECTIONS

After the exothermic weld has cooled, slag shall be removed and the weld tested with a glancing blow with a 16 ounce hammer to assure proper metallurgical bond.

7-11.3(16) ELECTRICAL INSULATION OF WATER MAIN**7-11.3(16)A GENERAL**

The Water Main shall be installed so as to maintain electrical insulation from dissimilar pipe material, other water Structures, and other underground installations.

7-11.3(16)B TESTING OF INSULATING COUPLINGS OR INSULATING FLANGE KITS

Insulating couplings or insulating flange kits shall be located and installed as shown on the Drawings. The Contractor shall install an electrolysis test station at each insulating device. The Contractor shall notify the Engineer at least 72 hours in advance for the SPU Corrosion Engineer to perform a functional test of the insulating couplings and flange kits. All damaged or defective insulating devices shall be replaced at the Contractor's sole expense.

7-11.4 MEASUREMENT

Bid items of Work completed pursuant to the Contract will be measured as provided in Section 1-09.1, Measurement of Quantities, unless otherwise provided for by individual measurement paragraphs herein this Section.

Measurement for "Pipe, Water Main, (Material), (Class), (Size), including Fittings", will be per linear foot based on the slope distance from point to point. The point of beginning or ending of measurement in any particular run of pipe will be either with the vertical intersection of the center line of the intersecting pipe, or with the beginning or ending of any new pipe installed. No deductions will be made for the linear length of fittings, valves, couplings, etc. contained within the measured length. At changes in pipe size connected by a reducer, the point of measurement will be taken as the midpoint of the reducer.

Measurement for "Blocking, Cement Concrete" will be by the cubic yard of concrete placed as computed by the Engineer.

Measurement for "Blowoff Assembly, (Size)" will be per each complete blowoff assembly installed which includes not in excess of 10 feet more than the length of blowoff connection pipe indicated on the Drawings as part of the each.

Measurement for "Steel Casing Pipe, (Class), (Size), (Underground Construction Method)" will be per linear foot actually installed and measurement shall not include directional drilling as specified in Section 7-22.4.

Measurement for "Station, Electrolysis Test" will be per each installed complete.

7-11.5 PAYMENT

Compensation for the cost necessary to complete the work described in Section 7-11 will be made at the Bid item prices Bid only for the Bid items listed or referenced as follows:

1. **"Pipe, Water Main, (Material), (Class), (Size), (Coating), including Fittings", per linear foot.**

The Bid item price for "Pipe, Water Main, (Material), (Class), (Size), (Coating), including Fittings" shall include all costs for the work required as follows:

- (1) Costs required for excavating, installing and joining pipe, backfilling and compacting native material, and disposing of and/or placing excess native material elsewhere;
- (2) Cost of Materials, including but not limited to, the pipe, fittings and pipe supports, locating wire, special coatings, and other items called for in the Contract. Where required, the costs of sand or foam cushioning between the Water Main and other pipes shall also be included;

- (3) Costs for the work required to furnish and install mechanical joint sleeves and pipe supports, including pipe hanger rods with nuts, single pipe rolls, steel angles, reinforcing bars, nuts, bolts, washers, mastic, and galvanizing;
- (4) Costs required to perform the "Taste Rating Test Procedures", "Procedures for Hydrostatic Pressure Testing", and "Procedures for Flushing, Disinfection and Bacteriological Sampling of New Water Mains";
- (5) Costs necessary for installing pipe on curves as shown on the Drawings, including field changes involving standard lengths of pipe deflected at the joints;
- (6) Costs of all Material, labor and equipment associated with making pipe connections unless otherwise specified; and
- (7) Costs of furnishing and installing service connecting tees 4-inches and larger.

Special fittings used but not called for on the Drawings will be paid for at the Supplier's invoice cost plus 15 percent for overhead and profit. Special fittings called for on the Drawings but not used will be deducted from the Contractor's final estimate based on the current cost to the Supplier of fittings used on the Improvement.

If the pipe, its lining or its coating is damaged, the Contractor will be required, at the Contractor's sole expense, to repair the damage to an acceptable condition prior to installation.

Payment for safety systems required for trench excavation work will be in accordance with Section 7-17.5.

Defective Material or workmanship discovered as a result of tests will be addressed in accordance with Section 1-05.7.

2. **"Blocking, Cement Concrete"**, per cubic yard.

The Bid item price for "Blocking, Cement Concrete" shall include all costs for the work required as follows:

- (1) Costs of placing concrete blocking including: excavation, turnbuckles, shackle rods, steel plates, concrete form work, finishing, removal and disposal of material not required for backfill; and
- (2) Other work that may be necessary for constructing the blocking in place as specified.

3. **"Blowoff Assembly, (Size)"**, per each.

The Bid item price for "Blowoff Assembly, (Size)" shall include all costs for the work required as follows:

- (1) Costs for furnishing and installing the complete assembly including corporation, fittings, pipes, valve, meter box or ring and cover, and all excavation, backfill with native material and compaction;
- (2) Costs to furnish and install the pipe between the corporation and the blowoff assembly including fittings; and
- (3) If the location of the blowoff assembly differs from that shown on the Drawings and requires an increase of more than 10 feet of connection pipe, the excess of pipe over 10 feet will be paid for in accordance with Section 1-09.4.

4. **"Steel Casing Pipe, (Class), (Size), (Underground Construction Method)"**, per linear foot.

The Bid item price for "Steel Casing Pipe, (Class), (Size), (Underground Construction Method)" shall include all costs for the work required as follows:

- (1) Costs for furnishing and installing the casing pipe by the underground construction method including but not limited to excavation and backfill of jacking pit(s); furnishing and placing sand filler, spacers, and sealing both ends with concrete; and installing, maintaining, and removing jacking pit support system; and
- (2) Costs to remove and replace damaged steel casing pipe deemed necessary by the Engineer.

Payment for directional drilling installation will be as specified in Section 7-22.5.

5. **"Pipe, Water Main, (Material), (Class), (Size), (Coating), including fittings, (Underground Construction Method)"**, per linear foot.

The Bid item price for "Pipe, Water Main, (Material), (Class), (Size), (Coating), including fittings, (Underground Construction Method)" shall include all costs for the work required to furnish and install the pipe, including placing the designated fill in the annular space when applicable.

Payment for directional drilling installation will be as specified in Section 7-22.5.

6. **"Station, Electrolysis Test"**, per each.

The Bid item price for "Station, Electrolysis Test" shall include all costs for the work required as follows:

- (1) Costs of furnishing and installing water meter box, test box, terminal blocks, wires, zinc reference electrodes, removal and restoration of sidewalks; and
- (2) All other Materials and labor required to complete this construction.

7. **"Bedding, Water Main, (Class), (Size) Pipe"**, per linear foot.

The Bid item price for "Bedding, (Class), (Size) Pipe" shall include all costs for the work required to furnish and install bedding to the cross section shown in Standard Plan no. 350. Cost of Class D bedding shall be included in the Bid item price for pipe Bid item and therefore no separate or additional payment will be made for Class D bedding.

8. **Other payment information.**

No separate payment will be made for electrical joint bonds. Costs for labor, material and equipment required to acceptably bond across mechanical couplings and across rubber gasket joints, and all incidentals required to provide acceptable and complete bonding shall be included in the Bid item price for "Pipe, Water Main, (Material), (Class), (Size), including Fittings".

Joint bonding Material shall include without being limited to all required cables, bolts, molds, cold applied tape coatings and heat shrink sleeves.

SECTION 7-12 VALVES FOR WATER MAINS**7-12.1 DESCRIPTION**

Section 7-12 describes work consists of furnishing and installing all Water Main valves and valve accessories as indicated in the Contract, and supplying all materials, tools and appurtenances needed to complete the installation.

7-12.2 MATERIALS

Materials shall meet the requirements of Section 9-30.3.

Valves for Water Mains shall be suitable for ordinary waterworks service and are intended to be installed in a normal position on buried Water Mains for water distribution and water transmission systems.

7-12.3 CONSTRUCTION REQUIREMENTS**7-12.3(1) GENERAL**

The Contractor shall not operate any valve on an existing Water Main.

All valves shall be inspected upon delivery in the field to ensure proper working condition before installation and to verify free of rust and dirt. The valves shall be set and jointed to the pipe according to the AWWA Standards, unless indicated otherwise in the Contract, for the type of connecting ends furnished. The valves shall be carefully inspected for damage to the outer protective coating(s) and verified damage free prior to installation.

An operating nut extension shall be installed when the ground surface is more than 30 inches above the valve operating nut. In standard valve boxes, which contain valves 12 inch and smaller, the operating nut extension shall extend into the top section of the standard valve box (see Standard Plan nos. 315a and 315b). In vaults, which contain valves greater than 12 inch, the operating nut extension shall extend into the upper section of the vault and shall clear the bottom of the lid within a range of 24 to 30 inches. The Contractor shall be prepared to furnish and install an operating nut extension when required. Upon delivery at the Project Site, all valves shall be opened to prevent the collection of water in the valve. Valves shall have the interiors cleaned of all foreign matter and shall be inspected both in open and closed position prior to installation. Valves shall be set perpendicular to the Water Main. Valve boxes shall be placed over the 12 inch and smaller valve or valve operator and any extension in a manner that the valve box makes no contact with the valve assembly or extensions and does not transmit shock or stress to the valve assembly or Water Main (see Section 7-12.3(4)). The lower casting of the valve box shall be installed first, so as to be supported by backfill and a polyethylene foam collar not less than 2 inches in thickness. The casting shall not rest directly upon the body of the valve or upon the Water Main. Backfill shall be carefully tamped around the valve box to a distance of 3 feet on all sides or to the undisturbed face of the trench if it is closer. The cast iron valve box cover shall be set flush to finished grade.

The combination air release/air vacuum valves shall be installed as shown on the Drawings. All piping shall be sloped to permit escape of any entrapped air. Backfilling and compaction shall be as specified in Section 7-10.

After installation, all valves shall be tested and disinfected in accordance with Sections 7-11.3(11) and 7-11.3(12). Should any defects in design, Materials installation, or workmanship appear during these tests, the Contractor shall correct such defects to an acceptable condition as determined by the Engineer.

7-12.3(2) VALVE CHAMBERS**7-12.3(2)A GENERAL**

This Section deals with the construction of valve chambers and special valve chambers.

Where shown on the Drawings, valve shall be enclosed in a valve chamber.

Valve chambers may be either precast or cast in place. The use of solid concrete blocks or concrete brick will be allowed only when indicated in the Contract.

Valve chambers and the casting assembly for valves larger than 12 inch shall make no contact with the valve assembly or extension where surface shock or stress can be transmitted to the valve assembly or Water Main.

7-12.3(2)B PRECAST VALVE CHAMBERS

The concrete base shall be poured-in-place or precast. Poured-in-place base shall be allowed to attain sufficient strength to support the chamber (usually 2 or 3 Days), as approved by the Engineer. Precast chambers shall be set on the concrete base in cement mortar. The vault chamber shall have adequately sized and located openings for chamber installation adequately clear of the Water Main.

The Water Main shall be wrapped with 2inch thick plastic foam Material at those areas where the Water Main intersects the chamber walls. The plastic foam Material shall cover the Water Main the full width of the chamber wall. Any remaining space between the chamber wall and the plastic foam Material shall be filled with cement mortar, and when the opening is large enough, brick and mortar. In no case shall the Water Main rest on the chamber wall.

7-12.3(2)C CHAMBERS MADE WITH PRECAST CONCRETE BLOCKS

Circular or rectangular chambers may be made with solid precast concrete blocks. The base shall first be poured in place. After the base has reached sufficient strength (usually 2 or 3 Days), the walls may be constructed of concrete blocks with water-tight cement mortar joints.

Circular chambers shall be constructed with curved manhole blocks. The chamber top shall be tapered in to the dimensions shown on the Standard Plans, unless the Contract specifies otherwise.

Chambers shall have a cast-in-place or precast concrete top slab suitable for H20 traffic loading.

7-12.3(2)D CAST-IN-PLACE CHAMBERS

Cast-in-place chambers may be constructed by using forms and poured concrete. Finishing of walls is not required other than the patching of porous spots (rock pockets) and bolt holes. Forms shall be removed for inspection of concrete.

7-12.3(3) SETTING FRAME AND COVER

The cast iron frame and cover (see Standard Plan no. 361) shall be set to grades furnished by the Engineer. Provisions for future adjustment of frame to changes in grade shall be made by constructing a minimum of 2 courses of brick with mortar joints between the top of the chamber and the bottom of the casting. Brick for this purpose shall be standard concrete brick 2-1/4 inches thick. When the casting is in concrete pavement or in rigid concrete base, reinforcement within the concrete pavement slab shall in accordance with Section 5-05.3(9).

7-12.3(4) SETTING VALVE BOX

Cast iron valve boxes shall be positioned during backfilling operations to be in vertical alignment with the gate valve operating stem. The lower casting of the unit shall be supported by a plastic foam collar not less than 2 inches thick, and shall be held in place by carefully compacted backfill. The casting shall not rest directly upon the body of the gate valve, operating nut extension, or upon the Water Main. The upper casting of the valve box shall be placed in the plane of and flush with the finished grade, and when installed on slopes may both need to be tilt adjusted and adequately offset to provide valve and extension clearances meeting the requirements of Section 7-12.3(1) and allow straight and direct access to the operating stem.

Compaction shall be as specified in Section 7-10.3(11).

7-12.3(5) VALVES INSTALLED ON SPECIALLY COATED PIPE

Valves installed on Water Mains that are polyethylene encased, tape coated, or special coated, shall be polyethylene encased, epoxy coated, or special coated the same as the Water Main.

7-12.3(6) LADDERS

Refer to Section 7-05.3(1)Q.

7-12.3(7) PAINTING OF VALVES

7-12.3(7)A PAINTING AT FACTORY

After the factory test and inspection, all ferrous parts of the valves except finished or bearing surfaces shall be painted inside and out with two coats of asphalt varnish, Federal Specification TT-V-51A or approved equal.

7-12.3(7)B PAINTING IN THE FIELD

The valve shall be carefully inspected for injury to the outer protective coatings. At all places where the coating has been ruptured or scraped off, the damaged area shall be thoroughly cleaned to expose the iron base, and the cleaned area shall then be recoated with the manufacturer's recommended primer and the entire valve shall be field painted with two or more coats of Royston Roskote 612XM, or equal, per manufacturer's instructions.

7-12.3(8) THERMOPLASTIC POWDER COATING

Valves and attachments to be installed on Water Mains where the Contract specifies Thermoplastic Powder Coating for the Water Main, shall also have a coating equivalent such as fusion bonded epoxy, or polyurethane, or approved equal.

All bolts, nuts, followers, and similar shall be wax tape coated (see Section 9-30.1(6)F).

Substitute Material requires the Contractor to submit the sufficient information and a Manufacturer's Certificate of Compliance stating that the proposed substitute Material shall perform at least as well as that specified.

7-12.4 MEASUREMENT

Bid items of Work completed pursuant to the Contract will be measured as provided in Section 1-09.1, Measurement of Quantities, unless otherwise provided for by individual measurement paragraphs herein this Section.

7-12.5 PAYMENT

Compensation for the cost necessary to complete the work described in Section 7-12 will be made at the Bid item prices Bid only for the Bid items listed or referenced as follows:

1. "Valve, Gate, (Size)", per each.
2. "Valve, Butterfly, (Size)", per each.

The Bid item price for "Valve, (Type), (Size)" shall include all costs for the work required to furnish and install the valve, including painting, jointing, disinfecting, hydrostatic testing, operating nut and extensions.

When the valve is to be polyethylene encased or coated as specified in the Contract, the cost for furnishing and installing the coating as specified in Section 7-12 shall be included in the Bid item price for "Valve, (Type), (Size)".

3. "Valve Chamber, (Type), (Size)", per each.

The Bid item price for "Valve Chamber, (Type), (Size)" shall include all costs for the work required to furnish and install the precast concrete, brick and block, or cast-in-place chamber, including foundation, adjustment brick, castings and lid, ethafoam cushion, mortar plastering, valves, support piers, water proofing Materials and steps or ladders.

4. **“Valve Box, Cast Iron”,** per each.

The Bid item price for “Valve Box, Cast Iron” shall include all costs for the work required to furnish and install the valve box, including plastic foam cushion.

SECTION 7-13 RESERVED

SECTION 7-14 HYDRANTS

7-14.1 DESCRIPTION

See Section 2-07.3 regarding hydrant use.

These Specifications are to be used in conjunction with the AWWA Standard C502 for dry barrel hydrants for ordinary water works service.

Section 7-14 describes work consisting of installing and setting and adjusting hydrant; and furnishing, installing and setting the hydrant tee, auxiliary valve, restraint system and shackles, gravel drain, concrete blocks, shear block, bleeder, hydrant connection, connection pipe, marker posts, retaining wall and rock facing, coating, painting, excavation, backfilling, furnishing and installing hydrant markers and quick connect adapters when required, and other pertinent Work as specified in other Sections of this Specification. The work also includes flushing, hydrostatic pressure testing and disinfecting of furnished hydrants and hydrant barrel extensions. The Contractor shall check and tighten any loose bolts on the hydrant prior to installation.

Hydrants will be furnished by SPU Water Operations. When required by the Engineer, hydrant barrel extensions kits will be furnished by SPU and installed by the Contractor prior to hydrant pressure testing. The Contractor shall take delivery of, and responsibility for, hydrants and extension kits provided at the Water Operations Center (2700 Airport Way South, Seattle) and shall transport them to the Project Site. The Contractor shall notify the Engineer at least 5 Working Days in advance to schedule hydrant pick-up and extension kit pick-up, and at least 2 Working Days in advance for hydrant installation. One hydrant extension kit, sized as determined by the Engineer, will be provided for each hydrant requiring adjustment. The Contractor shall flush, test and disinfect furnished hydrants and hydrant barrel extensions according to Section 7-11.3.

7-14.2 MATERIAL

Materials shall meet the requirements of Section 9-30.

Hydrants will be furnished by SPU. Arrangements for hydrant pickup will be addressed per Section 1-08.1(2).

7-14.3 CONSTRUCTION REQUIREMENTS

7-14.3(1) SETTING HYDRANTS

Where shown on the Drawings, hydrants shall be installed in accordance with the detail shown on Standard Plan nos. 310a through 314. Hydrants shall not be installed within 3 feet of a traveled roadway. In addition, a minimum 4-foot radius unobstructed working area shall be provided around all hydrants. The bottom surface of the breakaway flange shall be set 2-inches minimum and 7-inches maximum above the sidewalk or shear pad finished grade.

For each hydrant requiring vertical adjustment, see Section 7-14.1.

All barrel adjustment risers are to be positioned between the hydrant foot assembly and the barrel section provided with the hydrant. The companion extension for the hydrant main stem is to be positioned on the valve stem immediately below the stem section contained within the hydrant curb stand or discharge section.

After installation hydrants shall be subjected to a hydrostatic test as specified in Section 7-11.3(11).

The hydrant excavation shall be backfilled when installation and testing are complete and accepted by the Engineer.

A concrete shear block, as shown by the hydrant details on Standard Plan nos. 310a through 311b, shall be constructed if the hydrant is not in a concrete sidewalk. Construction, Materials, and finishing of the concrete shear block shall conform with Section 8-14, Cement Concrete Sidewalk. The shear block shall be set flush with the immediately surrounding finish grade.

After all installation and testing is completed, the hydrants shall be painted in accordance with Section 7-14.3(11).

Any hydrants not in service shall be identified by covering with a burlap or plastic bag.

7-14.3(2) HYDRANT CONNECTIONS

7-14.3(2)A GENERAL

Hydrant laterals shall consist of a section of 6-inch ductile iron pipe from the Water Main to the hydrant and shall include an auxiliary gate valve set vertically and placed in the line as indicated in the Standard Plans.

7-14.3(2)B HYDRANT RESTRAINT

Hydrant assemblies constructed with ductile iron pipe shall be restrained with mechanical joint restraint gland such as EBAA Iron Megalug Series 1100 or approved equal.

Hydrant assemblies that modify existing cast iron hydrant branch pipe shall be restrained with two ¾ inch diameter steel shackle rods as shown on Standard Plan nos. 310a and 311a.

Threads shall be cut at the ends or where rod couplers are needed. Slip joint pipe and fittings will not be allowed.

Shackle rods, nuts, washers, and couplers shall be completely coated pursuant to Section 9-30.15.

7-14.3(2)C AUXILIARY GATE VALVE AND VALVE BOX

Auxiliary gate valves and boxes shall be installed in accordance with Section 7-12. When an auxiliary valve called for in a 311b installation is located within an area subject to lawful vehicle parking, a second auxiliary valve shall be used in place of the MJ x flange adapter at the inlet of the hydrant. See Standard Plan nos. 310b and 311b for additional hydrant valve requirements.

7-14.3(3) RESETTING EXISTING HYDRANTS

Resetting hydrants, or moving an existing hydrant closer to or farther away from a Water Main on an existing hydrant connection, will be performed by SPU Water Operations.

When the Contract specifies the resetting of an existing hydrant, the hydrant shall be reset without disturbing the location of the hydrant lateral tee at the Water Main.

The hydrant shall be shackled as specified in Section 7-14.3(2)B.

This work shall be in accordance with Section 7-14.3(1).

7-14.3(4) RELOCATING EXISTING HYDRANTS

Relocating hydrants, or moving an existing hydrant and connection pipe to a new location, will be done by SPU Water Operations crews.

7-14.3(5) RESERVED

7-14.3(6) HYDRANT BARREL EXTENSIONS

The minimum requirements for hydrant barrel extensions, operating stems, and flanged adapters shall conform to AWWA C502 in design, Material, and workmanship. The drilling of the flanges on the extensions shall match the drilling of the flange that joins the hydrant foot section to the factory-supplied barrel section on the hydrant. All bolts used with barrel connection flanges shall engage the flanges through drilled bolt holes. Slotted bolt holes shall only be used on above-grade breakaway flange connections when the function of the breakaway feature requires their use.

7-14.3(7) RESERVED

7-14.3(8) RESERVED

7-14.3(9) RETAINING WALLS FOR HYDRANTS

Where indicated on the Drawings, the Contractor shall furnish and place a broken concrete slab wall around hydrants in accordance with Standard Plan no. 313 and Section 8-15.3(5)A. The broken concrete slabs shall be a minimum of 3-1/2 inches in thickness and not less than 3 feet x 1.5 feet in size. The slabs shall be set in level layers of the same thickness, and the exposed faces shall be as smooth as the shape and size of the slabs permit. The backfill behind the wall shall be Mineral Aggregate Type 2, in accordance with Section 9-03.

Rock facing rock may be used in place of broken concrete slab (see Standard Plan no. 141 and Section 2-08.3(5)). The depth of keyway shall be as shown in Standard Plan no. 141.

Ecology blocks may also be used in place of broken concrete slab. The keyway, Mineral Aggregate Type 2 filter Material, and geotextile shall be as shown in Standard Plan no. 313.

7-14.3(10) HYDRANTS ON WATER MAINS THAT ARE POLYETHYLENE ENCASED, MULTI-LAYERED POLYETHYLENE ENCASED, OR SPECIALLY COATED

Unless the Contract specifies otherwise, hydrants installed on special coated Water Mains, such as polyethylene encased, multi-layered polyethylene encased, thermoplastic coated, or other special pipe coating per Contract, the following shall be required:

1. Hydrant Connections up to and not including the hydrant (See Section 7-14.3(2)) shall have the same coating as the Water Mains to which they are connected, and shall have Class B bedding in accordance with Section 7-10.3(9);
2. Hydrant barrels below ground shall have the same special coating as the Water Main to which they are connected with the exception of thermoplastic coating;
3. Hydrants connected to thermoplastic coated Water Mains shall have the hydrant barrel below ground polyethylene encased. Thermoplastic coating of the hydrant will not be allowed; and
4. Hydrant connection shall be installed as specified in Section 7-11.3(6).

7-14.3(11) HYDRANT FIELD PAINTING

7-14.3(11)A BELOW GROUND COATING

Following hydrant installation and prior to backfill, any damaged coating on the below-ground portion of the hydrant shall be repaired with the same coating as recommended by the coating manufacturer and approved by the Engineer.

7-14.3(11)B ABOVE GROUND COATING

After shear pad construction or final surface restoration, the hydrant curb stand section including all exposed surfaces of the sidewalk flange shall receive two coats of oil based gloss enamel paint (Kelly-Moore Luxlite or approved equal) in Caterpillar yellow. Based on the elevation of the hydrant within the surrounding pressure zone, if the maximum static pressure

at the hydrant is less than 60 psi, the engine port cap on the hydrant shall be painted with two coats of oil based gloss enamel paint (Kelly-Moore Luxlite or approved equal) as indicated by the notes on Standard Plan nos. 310a and 311a.

7-14.4 MEASUREMENT

Bid items of Work completed pursuant to the Contract will be measured as provided in Section 1-09.1, Measurement of Quantities, unless otherwise provided for by individual measurement paragraphs herein this Section.

Measurement for rock facing and for ecology block hydrant walls will be in accordance with Section 2-08.4 as for the Bid item "Rock Facing".

Measurement for concrete slab hydrant wall will be in accordance with Section 8-15.4.

Measurement for hydrant and hydrant connection will be per each.

Measurement for Mineral Aggregate for hydrant walls will be in accordance with either Section 4-01.4 by the ton.

7-14.5 PAYMENT

Compensation for the cost necessary to complete the work described in Section 7-14 will be made at the Bid item prices Bid only for the Bid items listed or referenced as follows:

1. "Hydrant, 6-Inch Connection (Type)", per each.

The Bid item price for "Hydrant, 6-Inch Connection (Type)" shall include all costs for the work required to pickup, deliver and install a Type 310 or Type 311 hydrant, and furnish and install on new Water Main (or existing Water Main with existing tee) complete including but not limited to excavation; backfill with suitable material; disposal of material; furnishing and installing auxiliary valve, valve box, restraint system and shackles, barrel extension, gravel drain, concrete blocks, bleeder, special coating, field painting, shear block, marker posts, the 6-inch ductile iron pipe connection between the hydrant and the Water Main, any hydrant marker or quick connect adapter required; and obtaining the hydrant and hydrant extension.

2. Other payment information.

Payment for rock facing, for ecology block hydrant walls, and for filter drainage Material will be as specified in Section 2-08.5.

Payment for concrete slab hydrant wall and for filter drainage Material will be as specified in Section 8-15.5.

All costs in connection with furnishing and installing coatings and field painting as specified in this 7-14 Specification Section shall be included in the hydrant Bid item price(s).

Payment for bedding for polyethylene encased, multi-layered polyethylene encased, or special tape coated hydrant connection pipe will be in accordance with Section 7-11.5.

All costs associated with installing and removing temporary blocking, and removing existing blocking when indicated in the Contract shall be incidental to the various Bid items and no separate or additional payment will be made therefore.

SECTION 7-15 WATER SERVICE CONNECTION TRANSFERS

7-15.1 RESERVED

7-15.2 RESERVED

7-15.3 CONSTRUCTION REQUIREMENTS

The Contractor shall provide the Engineer at least 10 Working Days advance notice when transfer of existing water service is required.

Service transfers may not be done until the new Water Main has been tested and accepted, and then connected.

Unless the Contract specifies otherwise, SPU Water Operations will, at no cost to the Contractor:

1. Mark the exact field locations of service taps and tees on services 2 inch and smaller. Locations of services larger than 2 inch will be identified in the Contract,
2. Make all excavations for the water service connections, and
3. Furnish and compact backfill including furnishing and placing temporary pavement patch.

The Contractor shall not remove or abandon existing pipe until either all existing service connections have been transferred to the new Water Main or temporary service has been provided, and the Engineer approves. The Contractor shall maintain the temporary pavement patch until completion of all work by SPU Water Operations. Adequate provisions shall be made by the Contractor during construction for the care and protection of both Water Mains and water services in use.

Actual scheduling of water service connections and related work will be addressed at the Preconstruction Conference to take into account the actual number of connections required, least inconvenience to existing water service customers, sequencing of work, and other operation and construction activity needs.

Where the Contract indicates 4 inch, 6 inch, or 8 inch service connections, the Contractor shall furnish and install tees, valves, plugs, and valve boxes. A 3 inch water service shall be considered a 4 inch water service. The tees shall be mechanical joint (MJ) x mechanical joint x flange (FLG). Valves shall be MJ x FLG, and removable plugs shall be MJ for the service connection. The MJ plugs will be returned to the Contractor after SPU Water Operations completes the service connections.

Upon completion of work by SPU Water Operations, the Contractor shall make all final adjustments of valve boxes, water meter boxes, and rings and covers to final grade at no cost to the Owner, and shall then make the final surface restorations in accordance with the Contract.

7-15.4 RESERVED

7-15.5 PAYMENT

All costs associated with water service connection transfers shall be included in the Bid item prices for the applicable Bid items and no separate or additional payment will be made.

SECTION 7-16 FLOW CONTROL SYSTEMS

7-16.1 DESCRIPTION

Section 7-16 describes work consisting of excavation, shoring, foundation preparation, bedding, jointing, backfilling and compacting for the construction of a flow control structure and detention pipe for storm water storage. The flow control structure shall consist of manhole structure with a flow control device.

Trenching and excavating for flow control systems are subject to the provisions of Section 7-17.3(1)A. Trench safety shall comply with 7-17.3(1)A7a, Trench Safety Systems.

7-16.2 MATERIALS

Materials shall meet the requirements of the following Sections:

Flow Control Structure, Conduit, Fittings, and Related	9-05
Manhole Components	9-12
Non-Shrink Cement Sand Grout	9-04.3(2)

Corrugated metal pipe (CMP) flow control systems and detention systems will not be allowed in any landslide-prone area as defined in SMC 25.05.908.

Corrugated metal pipe flow control systems and detention systems which are to be owned, or to be maintained, by the City will not be allowed.

Flow control systems to be owned, or to be maintained, by the City shall be concrete.

7-16.3 CONSTRUCTION REQUIREMENTS

7-16.3(1) GENERAL

All work including excavation, foundation preparation, bedding, pipe installing and jointing, and backfilling for the construction of detention pipe and flow control Structure shall be in accordance with Sections 7-05 and 7-17.

7-16.3(2) FLOW CONTROL STRUCTURE

The PVC orifice plate shall be fusion-welded to the PVC cross or tee with an orifice of the diameter indicated on the Drawings drilled in its center.

The PVC shear pin shall be 3/4-inch in diameter and shall be fastened with a PVC cotter pin and stainless steel washer.

One end of the shear gate chain shall be attached to the shear gate and the other end shall be attached to a galvanized anchor bolt embedded in the leveling block. The chain shall be slack when the gate is closed.

After pipes have been placed in their final positions, openings in the walls of the flow control structure shall be grouted in place to present a smooth, flush with inner and outer surfaces of walls.

7-16.3(3) DETENTION PIPE

Seams in pipes and bands shall be gasketed in accordance with AASHTO M 196.

The end plate shall be welded to the end of the detention pipe with a watertight continuous weld.

The end of the detention pipe inside the flow control structure shall be ground smooth of all burrs and sharp edges.

Aluminum that is to be in contact with a Portland cement product (controlled density fill, concrete, grout, mortar, and other similar products) shall be protected as specified in Section 9-05.6(1).

See Section 7-16.2 regarding limitations on uses of several Materials.

Bedding for the detention pipe shall be Class B, using Mineral Aggregate Type 22 as indicated on the Drawings.

Coupling bands for steel detention pipes shall be Type "D" per WSDOT Standard Plan no. B-13a.

7-16.3(4) TEE CONNECTION TO CORRUGATED PIPE

Drainage pipes connected to corrugated detention pipe shall be made through a shop fabricated tee as shown on the Drawings and shall be installed in accordance to Section 7-17.3(2)C2. Tee shall be made to conform to size of detention pipe and sized to accept only rubber joint pipe.

7-16.3(5) TESTING

Testing of flow control systems for leakage shall be in accordance with Section 7-17.3(4)B.

All detention systems shall be tested in accordance with Section 7-17.3(4)B. Approval will not be given unless the detention system passes this test. The Contractor shall notify the Engineer at least 5 Working Days in advance of testing.

7-16.4 MEASUREMENT

Bid items of Work completed pursuant to the Contract will be measured as provided in Section 1-09.1, Measurement of Quantities, unless otherwise provided for by individual measurement paragraphs herein this Section.

Measurement for "Flow Control Structure, (Diameter)" will be by each Structure complete in place.

Measurement for the "Pipe, Detention, (Material) (Size)" will be by linear foot for the actual length of pipe installed from inside face of flow control Structure to end plate. No separate or additional measurement will be made for the air vent when applicable.

Measurement for outlet pipe will be in accordance with Section 7-08.4.

Measurement for trench safety systems will be in accordance with Section 7-17.4.

7-16.5 PAYMENT

Compensation for the cost necessary to complete the work described in Section 7-16 will be made at the Bid item prices Bid only for the Bid items listed or referenced as follows:

1. **"Flow Control Structure, (Diameter)", each.**

The Bid item price for "Flow Control Structure, (Diameter)" shall include all costs for the work required to furnish and construct the flow control Structure and internal appurtenance complete in-place including excavation, backfill and compaction with suitable native material, gravel bedding or foundation Material, making the connection with outlet pipe, and flexible adapter coupling.

2. **"Pipe, Detention, (Material), (Size)", per linear foot.**

The Bid item price for "Pipe, Detention, (Material), (Size)" shall include all costs for the work required to furnish, install, and test for leakage the detention pipe and end plate, grinding smooth the end of the detention pipe in the flow control structure, cleaning and painting the aluminum or steel surfaces as specified and all applicable work listed for the Bid item "Pipe, (Use), (Material), (Class), (Size)" of Section 7-17.5.

If an air vent is required by the Contract, all costs for fabricating and installing it shall be included in the Bid item price Bid for "Pipe, Detention, (Material), (Size)" And no separate or additional payment will be made.

3. **Other payment information.**

The outlet pipe of the flow control structure will be paid as "Pipe, Catch Basin Connection (Material), (Class), (Size)" per Section 7-08.5.

Tees required outside the flow control Structure will be paid as specified in Section 7-17.5.

Payment for trench safety systems will be as specified in Section 7-17.5.

SECTION 7-17 STORM DRAINS AND SANITARY SEWERS

7-17.1 DESCRIPTION

Section 7-17 describes work consisting of trench excavation, protective systems, foundation preparation, bedding, cut-in tees, pipe installing, jointing, backfilling, compacting and testing for the construction of Storm Drain, and sanitary and combined Sewer.

All reference to "Sewer" in Specification Section 7-17 shall apply equally to construction of sanitary Sewer, combined Sewer, and Storm Drain. Side Sewer is addressed in Section 7-18.

7-17.2 MATERIALS

7-17.2(1) GENERAL

Pipe Material used for sanitary Sewers, combined Sewers, and Storm Drains will be specified on the Drawings and may be one or more of the following:

Flexible Pipe Material	Rigid Pipe Material
Polyvinyl Chloride (PVC)	All Concrete
Acrylonitrile butadiene styrene (ABS)	Ductile Iron
Corrugated Metal	Vitrified Clay
Spiral Rib	
Polyethylene (PE)	

Aluminum or steel corrugated pipe may be used for Storm Drain when specified in the Contract.

Pipe shall have flexible gasketed joints unless otherwise specified in the Contract.

It is not intended that Materials listed be considered equal or generally interchangeable for all applications. The Engineer will determine from the Materials listed, those that are suitable for the project and will so specify in the Contract.

Materials shall meet the requirements of the following sections:

Joint Materials and Non-Shrink Cement Sand Grout	9-04
Pipe	9-05
Controlled Density Fill (CDF) - Pipe Bedding & Trench Backfill	9-01.5

All pipe shall be clearly marked with type, class, date of manufacture, location of manufacturing plant, and thickness. Lettering shall be legible and permanent under normal conditions of handling and storage. Concrete pipe with elliptical reinforcement shall be clearly marked on the inside and outside of the pipe along the minor axis to identify top and bottom.

After installation, pipe shall be tested for leakage in accordance with Section 7-17.3(4).

7-17.2(2) PROOF TESTS (PREQUALIFICATION)

The intent of this requirement is to pre-qualify a joint system, components of which meet the above requirements, as to the water tightness of that joint system. This proof test shall apply to all pipes which are to be tested for water tightness prior to acceptance. Materials and test equipment for proof testing shall be provided by the manufacturer. When approved by the Engineer, internal hydrostatic pressure may be applied by a suitable joint tester. See test requirements in the following Sections:

Joints	9-04
Pipe	9-05

7-17.2(3) MATERIAL CERTIFICATION

The manufacturer or fabricator shall furnish a Manufacturer's Certificate of Compliance, based on manufacturer's routine quality control tests, that the pipe meets or exceeds the requirements of the pertinent ASTM or ANSI specification.

7-17.3 CONSTRUCTION REQUIREMENTS

7-17.3(1) EXCAVATION AND PREPARATION OF TRENCH, PIPE BEDDING, AND CLAY DAM

7-17.3(1)A TRENCH EXCAVATION

7-17.3(1)A1 GENERAL EXCAVATION REQUIREMENTS

All open excavations including trenches shall comply with the requirements of WAC Chapter 296-155.

The length of Sewer trench excavation in advance of pipe installation shall be kept to a minimum and in no case shall exceed 150 feet.

Sidewalk, pavement, appurtenant structure, adjacent improvement and underground installation shall not be undermined or disturbed.

The maximum trench width between the bottom of excavation and the top of the pipe shall be in accordance with Standard Plan no. 284. If the maximum trench width is exceeded without written authorization of the Engineer, the Contractor as directed by the Engineer shall provide pipe of higher strength classification and shall provide a higher class of bedding.

Trench width above the top of pipe in the Right Of Way within paved roadway, sidewalk, or other improved area and where near to structure or underground installation or other improvement, shall not exceed the maximum neatline trench width as indicated on Standard Plan no. 284. Outside the Right Of Way and in unimproved areas, trench width above the top of pipe may at the Contractor's option exceed the maximum trench width indicated on Standard Plan no. 284 by sloping or benching. However, all requirements for excavating, handling and disposing of excavated material, and placing and compacting replacement suitable backfill, outside of Standard Plan no. 284 neatline trench limits shall be at the Contractor's sole expense.

All ledgerock, boulders, stones, and any other object larger than 3 inch in any dimension shall be removed where within 6 inches in any direction from the pipe. The maximum size of aggregate within 6 inch of the pipe shall not exceed 1 inch per foot of pipe diameter and in no case shall exceed 3 inch.

Prior to installation of bedding and pipe, the trench bottom shall be brought to grade as indicated in the Contract for the type of bedding specified and if the trench bottom is disturbed, compacted to 90% as specified in Section 2-03.3(14)E for a one (1) foot depth to provide a foundation Capable of supporting the pipe in its proper position. Bedding and backfill Material shall be placed as indicated on Standard Plan nos. 285 and 284. Where Class D bedding is specified in the Contract, additional trench bottom preparation shall comply with Section 7-17.3(1)B.

Excavation for manholes and other Structures connected to the pipelines shall be sufficient to provide a minimum of 12 inches between the side surface of the Structure and the sides of the excavation.

All material excavated from trenches and piled adjacent to the trench shall be piled and maintained so that the toe of the slope is at least 2 feet from the edge of the trench. This material shall be piled to cause a minimum of inconvenience to public travel, and provision shall be made for traffic where necessary. Clear access shall be provided to all fire hydrants, water valves, and water meters. Surface drainage and runoff along gutters to storm drain facilities and along natural watercourses shall not be blocked. See Section 1-07 for other requirements.

The Contractor shall remove any support system or shield system or related system in such a manner as to not disturb bedding or backfill. Where bedding or backfill is disturbed, the Contractor shall reconsolidate these materials to specified requirements.

7-17.3(1)A2 EXTRA EXCAVATION

When, after excavating to the specified foundation level, if the material remaining in the trench bottom is determined unsuitable by the Engineer, then excavation shall be continued to such additional depth as directed by the Engineer.

All additional excavation directed by the Engineer or indicated in Contract which is beyond neatline limits indicated on Standard Plan nos. 284 and 285 will be considered "Extra Excavation".

Where foundation Material is required, it shall consist of Mineral Aggregate Type 2, unless the Contract or Engineer specifies otherwise.

7-17.3(1)A3 DEWATERING

During excavation, installation of pipeline, and placement of bedding and trench backfill, excavations shall be kept free of water. The Contractor shall control surface run-off so as to prevent entry or collection of water in excavations. The static water level within the excavation shall be drawn down a minimum of 1 foot below the bottom of the excavation so as to maintain the undisturbed state of the foundation soils and allow acceptable placement of any bedding or backfill to the required density.

At least 10 Working Days before dewatering is started, the Contractor shall submit to the Engineer, the method and installation including details of the dewatering system and groundwater recharge system as necessary, indicating number and type of equipment and pipelines including capacity(ies), dewatering pits and locations, water discharge locations, groundwater recharge locations and means of recharging the groundwater table where necessary, groundwater monitoring systems where necessary, an estimate of advance time to dewater the trench prior to work in the trench when necessary, filter systems and locations as necessary, and such other information to verify acceptable control and performance. Open and cased sumps shall not be used as primary dewatering for excavations deeper than 3 feet below the static water table.

The Contractor shall furnish, install, and operate all necessary equipment to keep excavations free from water during construction. The control of groundwater shall prevent softening of the bottom of excavations, or formations of "quick" or heaving conditions, or "boils". Dewatering systems shall be designed and operated so as to prevent any removal or flowing of native soils. Disposal of the water shall not cause injury to public or private property, or nuisance to the public. Sufficient pumping and power equipment in good working condition shall be available at all times for all emergencies, including power outage, and competent workmen shall be available at all times for the operation of the dewatering and recharge system.

The dewatering system shall be designed to prevent loss of foundation support to adjacent structure, underground installation, improvement, or the sides of an excavation, and may require recharging the groundwater outside the excavation.

The dewatering system shall be installed and operated so that the groundwater level outside the excavation is not drawn down to the extent that would damage or endanger adjacent structure, underground installation, sidewalk, pavement, other improvement, or property.

The release of groundwater to its static level shall be performed in such a manner as to maintain the undisturbed state of the natural foundation soils and supported soils, prevent disturbance of compacted bedding and backfill, and prevent flotation or movement of Structures, pipelines, Sewers, and Storm Drains.

All costs associated with dewatering the trench excavation and controlling groundwater shall be included in the various Bid Items and no separate or additional payment will be made therefore, unless the Contract specifies otherwise.

The Contractor is fully responsible for controlling groundwater.

7-17.3(1)A4 UNEXPECTED OBJECTS

Unexpected objects, such as stumps, railroad ties, buried pavement, etc., encountered in the trench excavation shall be removed and disposed of by the Contractor. Removal of unexpected objects will be considered incidental to pipe installation unless one or more of the following conditions are met:

1. The object(s) cannot be removed by the equipment or excavation method at hand; or
2. The trench width or depth must be increased.

In the event the Contractor meets condition 1 or condition 2 or both conditions listed immediately above, removal of the object will be paid in accordance with Section 1-04.7.

7-17.3(1)A5 TRENCH EXCAVATION IN SOLID ROCK

Solid Rock Excavation shall cover the removal and disposal of solid rock as defined in Section 2-03.1(2).

Materials removed shall be replaced with suitable excess excavated native Materials from adjacent trenches or roadway excavations, or from imported Mineral Aggregate Type or selected Material as specified by the Engineer.

7-17.3(1)A6 SURPLUS MATERIAL

Surplus Material obtained from trench excavation and determined to be suitable Material for use elsewhere on the Project Site by the Engineer shall be used as selected Material in accordance with Section 2-03.3(10).

Surplus Material obtained from trench excavation and not needed elsewhere on the project, and unsuitable material obtained from the trench excavation shall be disposed of in accordance with Section 1-07.3.

7-17.3(1)A7 PROTECTIVE SYSTEMS**7-17.3(1)A7a TRENCH SAFETY SYSTEMS**

Where trench excavation is deeper than 4 feet, the Contractor shall construct and maintain safety systems that meet the requirements of the Washington Industrial Safety and Health Act (RCW Chapter 49.17) including compliance with WAC

Chapter 296-155. Ditches, channels, and similar earth openings over 4 feet in depth may be considered trench excavation over 4 feet deep and may be subject to the requirements of the Washington Industrial Safety and Health Act (RCW Chapter 49.17, including WAC Chapter 296-155).

Protective systems for use in excavations more than 20 feet in depth shall be designed by a registered professional engineer (see Section 1-05.3(12)).

The Contractor's trench safety system shall be a protective system designed and maintained by a competent person and shall meet accepted engineering requirements or practices. This trench safety system may require the use of a support system in locations not designated in the Contract as requiring a support system.

The trench safety system shall protect the Work, existing property, utilities, underground installation, pavement, improvement, etc., and shall provide safe working conditions in the trench. The Contractor may use a shield system; however, all Work required by the Engineer outside neatline trench width indicated on Standard Plan no. 284 including but not limited to:

- 1) handling and disposal of excavated material;
- 2) additional backfill beyond neatline trench limits;
- 3) additional surface restoration beyond limits indicated in the Contract; and/or
- 4) repair of damage to adjacent structure, improvement, or underground installation,

caused by the Contractor's operations shall be at the sole expense of the Contractor and at no additional or separate cost to the Owner.

The Contractor shall control water to protect employees from potential hazards posed by water.

The protective system shall be removed from the trench, once the work in the excavation is complete, in a manner which provides an acceptable means of reconsolidating the bedding, backfill, or side support Material without disturbance to the pipe.

The use of horizontal strutting below the pipe barrel or the use of the pipe as support for trench bracing will not be permitted.

7-17.3(1)A7b SUPPORT SYSTEM

In addition to worker safety requirements specified in Section 7-17.3(1)A7a, where trench excavations are to be laterally supported as required in the Contract at locations indicated on the Drawings, the lateral support shall be a support system as defined in WAC 296-155-650. Support systems may consist of underpinning, bracing, shoring, sheeting, or any other protective system or combination of protective systems which provides support to an adjacent structure, underground installation, and the sides of an excavation. The support system shall also include the control of groundwater as specified in Section 7-17.3(1)A3. The Contractor shall employ methods of installing, maintaining, and removing the system causing the least disturbance. During installation of the system, and when the system is installed, the Contractor shall fill all voids behind the support system as necessary and when necessary to prevent loss of native soils or loss of soil support. When removing the support system, the Contractor shall coordinate reconsolidation of bedding as necessary, and with backfilling to minimize disturbance.

All costs for this work will be paid by the Bid item "Support System".

The Contractor shall submit Shop Drawings (Section 1-05.3) and design calculations (Section 1-03.5(12)) of the proposed support system including loading calculations, structural member and system calculations, and sufficient details of installation, maintenance, and removal concurrent with excavation, installation, removal, and backfilling.

7-17.3(1)B PIPE BEDDING

7-17.3(1)B1 GENERAL

Bedding, of the class or classes shown on the Drawings, shall be installed in accordance with Standard Plan no. 285, and shall include all the Materials and work within the limits of the bedding zones indicated on Standard Plan no. 285.

Unless otherwise specified in the Contract, bedding for rigid and flexible pipe shall be Class B except bedding for ductile iron pipe shall be Class D.

All classes of bedding shall provide uniform support along the entire pipe barrel, without load concentration at joint collars or bells. No blocking of any kind shall be used to adjust the pipe to grade except when used with embedment concrete. Bell holes shall be excavated as required to ensure uniform support along the pipe barrel. Bedding disturbed by pipe movement or by removal of shoring or movement of a trench shield or box shall be reconsolidated prior to backfill. Special care shall be taken to provide adequate bedding support at wye or tee connections and adjacent to manholes or other Structures, so as to avoid bending or shearing stresses at these critical points.

7-17.3(1)B2 BEDDING FOR RIGID PIPE

Bedding shall be classified as Class A, Class B, Class C and Class D. The requirements and limits for the various classes of bedding are as shown on Standard Plan no. 285 and are described as follows:

1. **Class A Bedding:** Concrete for Class A bedding shall be Class 5 (1½) (see Section 5-05.3) and shall be a 4 sack minimum Portland cement concrete mix with 1½ inch maximum size aggregate. When placing the concrete bedding, the pipe shall be prevented from floating. Concrete shall be allowed to cure for a minimum of 12 hours prior to placing the Type 9 Mineral Aggregate bedding Material. Mineral Aggregate bedding shall then be placed in lifts of not more than 6 inches to a point 6 inches above the top of the pipe. Compaction of Mineral Aggregate Type 9 shall be to 90% as specified in Section 203.3(14)E. Before beginning work on concrete bedding, the Contractor shall submit a mix design for 1 -1/2 inch maximum size

- aggregate concrete with a 28 day strength of 4,000 psi to the Engineer for approval at least 5 Working Days in advance. It shall have a sufficiently fluid consistency to readily fill all voids around and under the pipe.
2. **Class B Bedding:** Class B bedding of Type 9 Mineral Aggregate shall be placed in at least three lifts. The first lift shall be placed before the pipe is installed and shall be a minimum of 4 to 6 inches in thickness (see dimension "A" on Standard Plan no. 285). The Material shall be spread smoothly so that the pipe is uniformly supported along the barrel. Subsequent lifts of not more than 6 inches shall be brought up to a point 6 inches above the top of the pipe. Each lift shall be brought up on both sides of the pipe and shall be carefully worked under the pipe haunches by means of slicing with a shovel, vibration, or other procedures approved by the Engineer. Compaction of bedding shall be to 90% maximum dry density as determined by methods specified in Section 2-03.3(14)E.
 3. **Class C Bedding:** Requirements for Class C bedding shall be the same as for Class B except that the Type 9 Mineral Aggregate shall extend only to the springline of the pipe. Selected native Material shall then be placed in 6 inch lifts to 6 inches above the pipe, using the same methods as those required for Class B bedding. Compaction of Mineral Aggregate Type 9 shall be to 90% maximum dry density as determined by methods specified in Section 2-03.3(14)E. Compaction of native Material shall be as specified in Section 7-17.3(3).
 4. **Class D Bedding:** Class D bedding shall be attained by carefully excavating the trench to proper grade, overexcavating at the bell sections, and placing and compacting selected Material around the pipe. Class D bedding and backfill shall be in accordance with Section 7-17.3(3).

Where unauthorized excavation has been made below the established grade, the Contractor shall provide, place, and compact suitable bedding Material to the proper grade and elevation. If the Engineer substitutes imported Mineral Aggregate Type in lieu of the selected native Material shown for Class C and for Class D bedding on Standard Plan no. 285, the bedding will be measured and paid for as "Bedding, Class B, (Size) Pipe".

7-17.3(1)B3 BEDDING FOR FLEXIBLE PIPE

All references to this Specification Section regarding Water Main trench excavation shall make reference to Standard Plan no. 350 unless specified otherwise in the Contract, and any Water Main reference to Standard Plan nos. 284 and/or 285 shall be interpreted as reference to Standard Plan no. 350 unless the Contract specifies otherwise.

Bedding for flexible pipe shall be Class B bedding with Mineral Aggregate Type 22 placed in several lifts in accordance with Standard Plan no. 285. Before installing the pipe, a first bedding lift of 4 or 6 inch thickness, depending on pipe size, shall be placed. Then the pipe is installed. The bedding shall be spread smoothly so that the pipe is uniformly supported along the barrel. Subsequent lifts of not more than 6 inches thickness shall be installed to the crown of the pipe and individually compacted to 90% density as determined in Section 2-03.3(14)E. A further 6 inch lift of moderately compacted Material shall be placed over the crown of the pipe in a manner not to crush or disturb the pipe.

7-17.3(1)C CLAY DAM

Clay dam shall be as specified in the Contract.

7-17.3(2) INSTALLING SEWER PIPE

7-17.3(2)A SURVEY LINE AND GRADE

Pipe shall be installed to the true line and grade indicated in the Contract at the invert of the pipe. The limit of variance at the invert shall not exceed plus or minus 0.03 foot from true line and grade at the time of backfill, and in no case shall result in reverse flow or have a sag. Checking of the invert elevation of the pipe may be made by calculations from measurements on the top of the pipe.

The Contractor may use any method, such as "swede line and batter board", "laser beam", etc., which would allow accurate transfer of the control points provided by the Engineer to installing the pipe to the designated alignment and grade.

When using the "swede line and batter board" method, the Contractor shall transfer line and grade into the trench where they shall be carried by means of a taut grade line supported on firmly set batter boards at intervals of not more than 30 feet. Not less than three batter boards shall be in use at one time. Grades shall be constantly checked and in the event the batter boards do not line up, the work shall be immediately stopped, the Engineer notified, and the cause remedied before proceeding with the work.

When using a laser beam to set pipe alignment and grade, the Contractor shall constantly check position of laser beam from surface hubs provided by the Engineer to verify laser beam alignment and grade. In the event the laser beam is found out of position, the Contractor shall stop work and make necessary corrections to the laser beam equipment and to pipe installed.

7-17.3(2)B PIPE INSTALLATION AND JOINTING

7-17.3(2)B1 PIPE INSTALLATION

After an accurate grade line has been established, the pipe shall be installed in the properly dewatered trench. Mud, silt, gravel, and other foreign Material shall be kept out of the pipe. Pipe joints shall be kept clean and protected at all times, and shall be lubricated as recommended by the pipe manufacturer before joining.

All pipe installed in the trench shall be kept in longitudinal compression until the bedding has been placed and compacted around and over the pipe.

The Contractor shall exercise care in matching pipe joints for concentricity and compatibility. In no case shall two pipes be joined together with ends exceeding the maximum manufacturer's tolerance.

The pipe shall be installed in the up-grade direction from the point of connection from either the existing pipe or the designated Structure as the starting point. The pipe shall be installed with the bell end forward or upgrade.

When pipe installation is not in progress, any open end of the pipe shall be sealed with an approved temporary watertight plug.

7-17.3(2)B2 JOINTS – HAND MORTARED AND ON CURVES

Where pipelines are to be installed on specified curves of sufficiently short radius to deflect the pipe joints in an amount greater than recommended by the pipe manufacturer, the curves shall be achieved with a series of tangents and shop-fabricated bends complying with the pipe manufacturer's recommendations as approved by the Engineer. The Contractor shall submit the pipe manufacturer's recommendations for approval at least 5 Working Days in advance. Pipe invert shall comply with the requirements of Section 7-17.3(2)A.

Hand mortared pipe joints will not be allowed. All joints shall be water tight and meet the applicable test requirement(s) of Section 7-17.3(4).

See Section 7-17.3(2)E for gasketed jointing.

7-17.3(2)C PLUGS AND CONNECTIONS

7-17.3(2)C1 GENERAL

All fittings shall be capped or plugged with a plug of an approved Material gasketed with the same gasket Material as the pipe unit; or shall be fitted with an approved mechanical stopper; or shall have an integrally cast knock-out plug. The plug shall be able to withstand all test pressures without leaking, and when later removed, shall permit continuation of piping with jointing similar to joints in the installed line.

Should testing or television inspection indicate installed pipe is damaged or does not pass testing, the Contractor shall remove and replace the failed or damaged section of pipe. Should the Contractor believe the pipe which is damaged, or which failed the test, can be repaired by other than remove and replace, the Contractor shall submit a repair method for approval by the Engineer at least 5 Working Days in advance (see Section 1-05.7). The replaced, or repaired pipe, shall again be inspected and tested. Repairs using rubber boot type methods, such as FERNCO type coupler repairs, will not be allowed unless approved otherwise by the Engineer. See Section 7-17.3(4).

7-17.3(2)C2 FITTINGS

Unless otherwise specified in the Contract, tee fittings shall be provided in the Sewer and Storm Drains for side Sewers, catch basin connections and service drains. Tees shall be 8 inches inside diameter, except tees for side Sewers shall be 6 inches inside diameter unless indicated otherwise in the Contract. All fittings shall be of sufficient strength to withstand all handling and load stresses normally encountered. All fittings shall be of the same Materials as the pipe, except when core drilling to insert a tee, which shall be per Section 7-17.3(2)C3. Material joining the fittings to the pipe shall be free from cracks and shall adhere tightly to each joining surface. Fittings shall make for a water tight connection meeting the requirement(s) of Section 7-17.3(4).

All tees on new pipe less than 24 inch inside diameter shall be prefabricated.

7-17.3(2)C3 CUT-IN TEE ON EXISTING OR NEW PIPE

Unless the Contract indicates otherwise, the Contractor shall locate and cut a hole in the existing or new pipe centered at 30 to 45 degree angle to the springline. Springline is defined as the widest cross-section of the host pipe measured horizontally. Coring shall be done such that the cored out piece or other materials do not drop into the pipe. The Contractor shall notify the Engineer at least 2 Working Days in advance of cut-in tee operation.

Coring shall be performed in accordance with the following:

1. **Concrete Pipe Tee To Concrete Pipe:** A concrete tee may be installed on an existing concrete pipe 18 inches in diameter or larger by placing a short length of concrete pipe into the core-drilled hole with its bell end against the outside face of the pipe and the barrel end inserted just to the inside face of the pipe. The Contractor shall thoroughly clean the bonding areas between the tee and the pipe so that the surfaces are free of dirt, dust, grease, oil or other contaminants that may reduce the bond between the grout and the pipe surfaces. Both surfaces shall first be coated with a concrete bonding agent submitted for review and accepted by the Engineer. The annular space between the tee and the core-drilled surfaces shall then be tightly packed with non-shrink cement sand grout meeting the requirements of Section 9-04.3(2). The connection shall be neatly finished inside and outside the existing concrete pipe.
2. **Ductile Iron Tee To Existing Concrete Pipe:** The existing concrete pipe shall be core-drilled with a hole large enough to accommodate the barrel of the specified size of ductile iron pipe and provide a 1-inch space between ductile iron pipe and the existing concrete pipe for application of grout. A length of ductile iron pipe shall be cut so that it can be placed in the core-drilled hole with its bell end against the outside face of the existing pipe without the barrel protruding beyond the inside face of the existing pipe. The Contractor shall clean the outside of the ductile iron pipe, removing loose particles (dust, dirt, oil, or film of any sort) that may reduce the bond between the grout and the pipe. After core drilling, the exposed surface of the existing concrete pipe shall be rough and clean. Both surfaces shall be coated with a bonding agent submitted for review and approved by the Engineer. The annular space between the pipe and core drilled surfaces shall

be tightly packed with non-shrink cement sand grout meeting the requirements of Section 9-04.3(2). The connection shall be neatly finished inside and outside the existing concrete pipe.

3. **Saddle-Type Tee to Existing Ductile Iron Pipe:** The ductile iron pipe shall have a full-sized hole cut into it by core drilling or by the arc-weld flame cutting method. The Contractor shall obtain approval of the method from the Engineer at least 2 Working Days in advance. A saddle-type tapping tee, manufactured to fit the receiving pipe, shall be mounted after the contact area between tee and pipe has been cleaned of all dirt, sand, grit, grease and other foreign matter to ensure continuous contact by the straps.
4. **Corrugated Metal Tee To Corrugated Metal Pipe:** In corrugated steel and aluminum pipes, a hole shall be sawcut to match a shop fabricated tee as indicated in Standard Plan no. 279.
The flange plate of the fabricated tee shall be corrugated to match corrugation of the pipe to which it is attached. A neoprene gasket or approved equal shall be inserted between the outside face of the existing pipe and the flange plate of the tee and connected by bolting. Corrosion protection shall be provided if the pipe section of the tee is non-corrugated aluminum pipe.
The incoming pipe and the tee shall be connected with stainless steel rigid walled flexible coupling. If the pipe section of the tee is aluminum, corrosion protection shall be provided by isolating the aluminum from the steel by extending the gasket 1 inch beyond the edge of the stainless steel coupling.
5. **Inserta Tee To Clay Pipe:** The Contractor shall submit the method and type tee recommended by the tee manufacturer to the Engineer for approval at least 5 Working Days in advance.
6. **Inserta Tee to Concrete Pipe:** The Contractor shall core drill a full size hole in one operation to accommodate an Engineer approved PVC tee insert with a coupling fitting.

All existing pipe, 18 inch and smaller diameter, made of non-reinforced concrete or vitrified clay shall be fully exposed for inspection.

The excavation shall be backfilled and compacted per Section 7-17.3(3).

The Contractor shall notify the Engineer at least 2 Working Days before beginning cut-in operations (Note - The Engineer will notify the SPU Drainage and Wastewater Division @ 206-386-1230 for the South District or 206-684-7506 for the North District). The existing pipe shall be inspected by the Engineer for defects before the drilling or cutting operation starts, again during drilling or cutting operations, and after installation of the tee is completed to make certain that no defective parts or work remain undetected and uncorrected. If the Contractor has requested the Engineer to core drill the hole, the Contractor shall provide a tee made of the same Material and with the same corrugations as the cored pipe.

If the exposed pipe is found cracked or deformed, the Engineer will arrange for either roll in of a new pipe, or repair of the damage at no cost to the Contractor, provided the damage was not caused by the Contractor's operations. If the Engineer rolls in a new pipe with a tee already on it, no fitting will be required.

7-17.3(2)D PIPE MARKINGS

On elliptically reinforced concrete pipe, the markings indicating the minor axis of the reinforcement shall be placed in a vertical plane (top or bottom) when the pipe is installed.

7-17.3(2)E GASKETED JOINTS

Pipe handling after the gasket has been affixed shall be carefully controlled to avoid disturbing the gasket and knocking it out of position, or contaminating it with dirt or other foreign Material. Any gaskets so disturbed shall be removed, cleaned, replaced, and relubricated before joining the sections.

Care shall be taken to properly align the pipe before joints are entirely forced home. During insertion of the tongue or spigot, the pipe shall be partially supported by hand, sling, or crane to minimize unequal lateral pressure on the gasket and to maintain concentricity until the gasket is properly positioned. Since most gasketed joints tend to creep apart when the end pipe is deflected and straightened, such movement shall be held to a minimum once the joint is home.

Sufficient pressure shall be applied in making the joint to ensure that it is home, as described in the standard installation instructions provided by the pipe manufacturer. Sufficient restraint shall be applied to the line to ensure that joints once home are held so, until fill Material under and alongside the pipe has been sufficiently compacted. At the end of the work Day, the last pipe shall be blocked in an effective way to prevent creep.

Where pipe must be deflected to accommodate required horizontal or vertical curvature, it shall first be joined in straight alignment and then deflected as required. See Section 7-17.3(2)B2 for hand mortar joints and joints on curved pipe.

7-17.3(2)F JOINTING – BREAK-OUT AND RECONNECT & MISMATCHED WALL THICKNESS

Where it is necessary to break out or connect to an existing pipe, only new pipe having the same inside diameter shall be used in reconnecting the pipeline. Inverts, grade, and alignments are to match. Where joints must be made between pipes with a mismatched wall thickness, the Contractor shall use a flexible gasketed coupling, adapter or coupling-adapter to make a watertight joint. Couplings shall be those manufactured by "Romac", "Smith-Blair", or approved equal.

7-17.3(2)G STORM DRAIN AND SEWER CONNECTIONS

Catch basin, service drain, or side Sewer connections to Sewer and Storm Drain trunks, mains, or laterals, shall be left uncovered until after the Engineer has inspected and approved the work. After approval of the connection, the bedding and trench backfill work shall be completed.

7-17.3(2)H SIDE SEWER CONNECTION – OVERSIZED AND CLEARANCE REQUIREMENTS

Where a side Sewer is as large as or larger than the trunk, main, or lateral Sewer or Storm Drain to which it is to be connected, the connection shall be made only at a manhole unless otherwise provided in the Contract. The capacity of the proposed connection and capacity of existing trunk, main, or lateral Sewer or Storm Drain shall be verified and submitted to the Engineer for approval at least 15 Working Days in advance.

Side Sewers shall be installed below Water Main and shall meet the clearance requirements indicated on Standard Plan nos. 286a and 286b, and as specified in Section 1-07.17(2).

7-17.3(2)I PROTECTION OF EXISTING SEWER FACILITIES

All existing live Sewers including septic tanks and drain fields shall be kept in service at all times. Provision shall be made for disposal of sewage flow if any existing Sewer is damaged.

Water accumulating during construction shall be removed from the new pipeline but shall not be permitted to enter the existing system. The Contractor shall be responsible for flushing out and cleaning any existing pipeline into which gravel, rocks, or other debris has entered as a result of his/her operations, and shall repair lift stations or other facilities damaged by his/her operations.

The physical connection to an existing manhole or pipeline shall not be made until authorized by the Engineer. Such authorization will not be given until all upstream lines have been completely cleaned, all debris removed and, where applicable, a pipe has been temporarily placed in the existing channel and sealed.

7-17.3(2)J UNDERGROUND CONSTRUCTION

Directional drilling shall be in accordance with Section 7-22. Trenchless construction other than directional drilling shall be as specified in the Contract.

Where indicated on the Drawings, the Contractor shall install pipe by underground construction methods including jacking, augering, tunneling, microtunneling, or any other trenchless technology method or use of rapid excavation machine other than directional drilling, including installing the pipe in a casing pipe, or by any combination of these methods.

When casing pipe is required, and the size and gauge of pipe has not been specified in the Contract, the Contractor shall select the gauge and size of the casing pipe compatible with the underground construction operation and surrounding loading conditions. The Contractor shall take care to prevent caving ahead of the casing which would create voids outside the casing pipe. When the casing is in place, the carrier pipe shall be carefully skidded through the casing pipe and adjusted to the line and grade shown on the Drawing. The annular space between the casing and carrier pipes shall be filled with Material specified in the Contract.

Ground support in portal areas, shafts, and pits, whether launch, intermediate, or receiving, shall be designed to support adjacent structure, underground installation, the sides of excavation, and withstand all forces from jacking and other operations.

At least one designated person shall be on duty above ground whenever any employee is working underground. The Contractor shall have in place communications, hoisting equipment, emergency provisions, air quality monitoring, and ventilation equipment as necessary.

For other than directional drilling per Section 7-22, at least 20 Working Days in advance of underground construction activities, the Contractor shall submit 8 sets of Shop Drawings and all necessary calculations describing these activities, including dimensioning of shaft, pit, or portal; method of shaft excavation; method of underground construction; size of underground construction; staging and surface support; waste disposal particular to a specific underground construction; control equipment; qualifications of underground construction Contractor; a complete description of shoring including installation, maintenance, and removal; and a complete description of slurry handling and disposal system when applicable; in accordance with the requirements of Section 1-05.3. The submittal shall include the name of the designated person.

The material, procedure, and equipment employed by the Contractor shall not relieve the Contractor of responsibilities nor waive or modify any provisions of the Contract.

7-17.3(2)K TEMPORARY SEWER BYPASS

The Contractor shall install a temporary bypass to maintain uninterrupted Sewer service on projects calling for reconstruction of existing Sewer mains or on projects where construction Work will interfere with sewage flow in the existing Sewer. The bypass shall be made by diverting the effluent flow at an upstream access manhole and pumping it through a separate conduit to a downstream reentry point or to an adjacent Sewer system. The pump and bypass conduit shall be of adequate size and capacity to handle the flow. The effluent level in the bypass pumping manhole shall not be allowed to rise more than 1 foot above the crown of the incoming Sewer pipe. Work shall be conducted in such a manner as to comply with the requirements of Section 1-07.

A written proposal for bypassing the remaining portion of the Sewer system and the list of all equipment to be used for the Work shall be submitted by the Contractor to the Engineer, allowing at least 10 Working Days for review and return of comments. The Engineer's review shall not relieve the Contractor of its responsibilities or of any public liability for sewage spills under this Contract.

7-17.3(3) BACKFILLING TRENCHES**7-17.3(3)A GENERAL**

In backfilling the trench, the Contractor shall take all necessary precautions to protect the pipe from any damage or shifting. The Contractor shall backfill from the side of the trench to a uniform depth of 2 feet above the crown of the pipe, including the bedding, before starting compaction. See Section 7-17.3(3)B for Compaction Requirements.

During all phases of the backfilling operations and testing as outlined herein, the Contractor shall protect the pipe installation, provide for the maintenance of traffic as may be necessary, and provide for the safety of property and person.

The Contractor shall use suitable native excavated Material for trench backfill unless notified by the Engineer that the native Material is unsuitable. The Engineer will examine excavated native Material at the time of excavation to determine its suitability for use as backfill. Native Material will be considered suitable for trench backfill if it is:

1. Capable of attaining the degree of compaction specified in Section 7-17.3(3)B;
2. Within reasonable tolerance of optimum moisture content; and
3. Reasonably free of organic material, clay, frozen lumps, rocks or pavement chunks more than 6 inches in maximum dimension, or other deleterious matter.

Unsuitable backfill Material shall be removed from the Project Site, disposed of per Section 1-07.3, and replaced with Mineral Aggregate Type 17, selected Material, or such other imported Material as designated by the Engineer.

The Contractor shall take any necessary steps to protect the excavated Material from becoming contaminated with excessive moisture.

Where it is required that a blanket of selected Material or bank run gravel be placed on top of the native backfill, the backfill shall be placed to such elevation as shown on the Drawings, and shall be leveled to provide for a uniform thickness of the borrow Material. Compaction shall be required.

Pipe trenches shall be backfilled as soon as possible after the pipe installation. The Contractor shall not have more than 200 feet of trench open in which the pipeline has been completed, except by permission of the Engineer. Backfilling of trenches in the vicinity of catch basins, manholes, or other appurtenances will not be permitted until the cement in the masonry has become thoroughly hardened.

Walking on the pipe shall not be allowed until at least 1 foot of backfill has been placed upon it.

7-17.3(3)B COMPACTION OF TRENCH BACKFILL

Trench backfill shall be spread in lifts and be compacted by mechanical tampers of the impact type approved by the Engineer. The backfill Material shall be placed in successive lifts with the first lift not to exceed 2 feet above the pipe, and the following lifts not exceeding 12 inches in loose thickness, with each lift being compacted to the density specified as follows:

1. Improved areas such as street and sidewalk areas shall be compacted to 95% of maximum dry density; or
2. Unimproved areas or landscape areas shall be compacted to 90% of maximum dry density.

Compaction control tests shall be performed as specified in Section 2-03.3(14)E.

The procedure and equipment to be used for backfill compaction shall be demonstrated on a test section of pipeline to be located by the Engineer at the beginning of this work. The Contractor shall make these arrangements with the Engineer at least 2 Working Days prior to beginning this work.

The Contractor shall excavate test pits in the backfill as directed by the Engineer for the purpose of testing the backfill compaction.

If the required compaction density has not been obtained, the Contractor shall remove the backfill from the trench and recompact using heavier compaction equipment or more passes. This process shall be repeated until the Contractor has established a procedure that provides the required field density. The Contractor will then be permitted to proceed with backfilling and compacting the remainder of the pipeline under the approved compaction procedure.

In the event routine field densities taken during the course of construction show the specified compaction of backfill is not being obtained because of changes in soil types which are identified as suitable by the Engineer, the Contractor will be required to reestablish the compaction procedure. In no case will excavation, backfill, and pipe installation operations be allowed to proceed until the specified compaction of backfill is attained. Water settling will not be allowed as a method for compaction of backfill.

7-17.3(4) CLEANING AND TESTING**7-17.3(4)A GENERAL**

Pipelines and appurtenances shall be cleaned and tested, after backfilling, by the exfiltration or low pressure air method, at the Contractor's option, or by infiltration test if the ground water table is such that the Engineer may require it.

All work involved in cleaning and testing pipelines between manholes or rodding inlets as required herein shall be completed within 15 Working Days after backfilling of pipelines and Structures. Any delay shall be submitted to the Engineer well in advance and requires the written consent of the Engineer. The Contractor shall furnish all labor, Materials, tools, and equipment necessary to make the test, clean the lines, and perform all Work incidental thereto. The Contractor shall perform the tests in the presence of the Engineer. Precautions shall be taken to prevent joints from drawing apart during tests. Any damage resulting from these tests shall be repaired by the Contractor. The manner and time of testing shall be subject to approval by the Engineer.

All wyes, tees, and stubs shall be plugged using test tees, or acceptable alternate, securely fastened to withstand the internal test pressure. Such test tees shall be readily removable, and their removal shall provide a socket suitable for making a flexible jointed lateral connection or extension.

Testing of side Sewers including runoff and downspout connections shall comply with the requirements of Section 7-18.3(6).

7-17.3(4)A1 PIPE NOT PASSING TESTING

If any pipeline installation fails to meet the requirements of the test method used, or is indicated as defective by television inspection, the Contractor shall determine the source or sources of leakage and shall replace all defective pipe. Where the Contractor believes a repair can be made without removal, the Contractor shall submit to the Engineer for approval at least 5 Working Days in advance, the proposed repair. See Section 7-17.3(2)C1 for damaged connections or failed connections or plugs. The complete pipe installation shall meet the requirements of the test method used before being considered acceptable. Replacement or repair of defective pipe shall not commence until the Contractor has received approval of the method from the Engineer. Retest will be required for acceptance.

All lateral or side Sewer branches included in the test section shall be taken into account in computing allowable leakage.

Upon final acceptance of the Work, all Sewers, side Sewers and fittings shall be open, clean, and free draining.

7-17.3(4)B EXFILTRATION TEST

Prior to making exfiltration leakage tests, the Contractor may fill the pipe with clear water to permit normal absorption into the pipe walls, provided that after filling the pipe the leakage test is completed within twenty-four hours. When under test, the allowable leakage shall be limited according to the provisions that follow. Specified allowances assume pre-wetted pipe.

Leakage shall be no more than 0.28 gallons per hour ("gph") per inch inside diameter ("inch dia") per 100 linear feet ("LF") of pipe, with a hydrostatic head of 6 feet above the crown at the upper end of the test section, or above the natural groundwater table at the time of test, whichever is higher. The length of pipe tested shall be limited so that the pressure at the lower end of the section tested does not exceed 16 feet of head above the invert, and in no case shall the length be greater than 700 linear feet or the distance between manholes when greater than 700 linear feet.

Where the test head is other than 6 feet, the measured leakage shall not exceed 0.28 gph per inch inside diameter per 100 linear feet times the ratio of the square root of the test head to the square root of 6.

$$\text{Leakage maximum} = 0.28 \times \frac{\sqrt{H}}{\sqrt{6}} = 0.114 \times \sqrt{H} \quad \text{where leakage is in gph/inch dia/100 LF.}$$

When the test is to be made one joint at a time, the leakage per joint shall not exceed the computed allowable leakage per length of pipe.

An allowance of 0.2 gallons per hour per foot of head above invert shall be made for each manhole included in a test section.

All pipe and detention systems in, or near as indicated in the Contract, Environmentally Critical Areas designated geologically hazardous areas, shall require exfiltration testing. Approval will not be given unless the detention system passes this test. The Contractor shall notify the Engineer at least 5 Working Days in advance of proposed testing.

7-17.3(4)C INFILTRATION TEST

Infiltration test leakage shall not exceed 0.16 gallons per hour (gph) per inch inside diameter (inch dia) per 100 linear feet (LF) of pipe tested, when the natural groundwater head over the pipe is 2 feet or less above the crown of the pipe at the upper end of the test section. The length of pipe tested shall not exceed 700 linear feet or the distance between manholes when greater than 700 linear feet.

Where the natural groundwater head is more than 2 feet, the measured leakage shall not exceed 0.16 gph per inch inside diameter per 100 linear feet times the ratio of the square root of the natural groundwater head to the square root of 2.

$$\text{Leakage maximum} = 0.16 \times \frac{\sqrt{H}}{\sqrt{2}} = 0.114 \times \sqrt{H} \quad \text{where leakage is in gph/inch dia/100LF.}$$

When a suitable head of groundwater exists above the crown of the pipe and when the pipe is large enough to perform work inside it, acceptance may be based on there being no visible leakage. Where leakage is indicated, the repair methods shall be submitted in writing to the Engineer by the Contractor for approval (see Section 7-17.3(4)A1).

7-17.3(4)D AIR PRESSURE TEST FOR SEWERS CONSTRUCTED OF AIR-PERMEABLE MATERIALS

Vitrified clay pipe shall be air tested as specified in Section 9-05.4. For all other pipe Material:

1. Pipelines may be tested with low pressure air by the pressure drop method, in lieu of water infiltration or exfiltration. The pressure drop shall be from 3-1/2 to 2-1/2 psi greater than the average back pressure of groundwater above the springline of the pipe. At the Contractor's option, pipe may be tested without pre-wetting; however, the test allowances herein assume pre-wetted pipe.
2. The allowable rate of air loss shall be .003 cubic feet per minute (cfm) per square foot of internal pipe surface; however, the total air loss shall not exceed 3.50 cfm.

3. The test equipment to be used shall be furnished by the Contractor and shall be inspected and approved by the Engineer prior to use. The Engineer may at any time require a calibration test of gauges, other instrumentation, and equipment that is used for this test.
4. Safety Provisions. Plugs used to close the Sewer pipe for the air test shall be securely braced to prevent the unintentional release or loosening of a plug. Gauges, air piping manifolds, and valves shall be located at the ground surface. No person shall be permitted to enter a manhole where a plugged pipe is pressurized. (Four pounds per square inch gauge (psig) air pressure develops a force against the plug in a 12 inch diameter pipe of approximately 450 pounds, and a plug failure may result in injury.) Air testing apparatus shall be equipped with a pressure release device designed to relieve pressure in the pipe at a pressure recommended by the pipe manufacturer. The Contractor shall submit the pipe manufacturer's recommendations to the Engineer including the safety precautions for pipe testing.
5. Pipe with inside diameter less than 36 inches may be tested from manhole to manhole or on shorter lengths at the Contractor's option. Pipe 36 inches in diameter and over shall have all joints tested individually and in consecutive order along the entire line. The void volume around the joint shall be pressurized to 3.5 psi above that of the average groundwater pressure above the springline of the pipe. The Contractor shall allow the air pressure and temperature to stabilize before shutting off the air supply and start of test timing. Joint or joints will be determined acceptable if a pressure loss not exceeding 1.0 psi occurs over a 30 second test interval.

If a pipe joint fails to pass this pressure test or also fails a retest, it shall be repaired in a manner acceptable to the Engineer. If not repairable, the damaged pipe section shall be replaced with a new one and the joints tested as specified above.

7-17.3(4)E AIR PRESSURE TEST FOR PIPES CONSTRUCTED OF NON AIR-PERMEABLE MATERIALS

7-17.3(4)E1 GENERAL

Vitrified clay pipe shall be air tested as specified in Section 9-05.4.

For all other material pipe, when non air-permeable pipelines are subjected to the low pressure air test, all of the provisions of Section 7-17.3(4)D shall apply except that the pressure drop shall be from 3.5 to 3.0 psig greater than the average back pressure above the center of the pipe, and the minimum time shall be twice that computed as specified under Section 7-17.3(4)D.

7-17.3(4)E2 RECOMMENDED PROCEDURE FOR CONDUCTING ACCEPTANCE TEST BY PRESSURE DROP METHOD

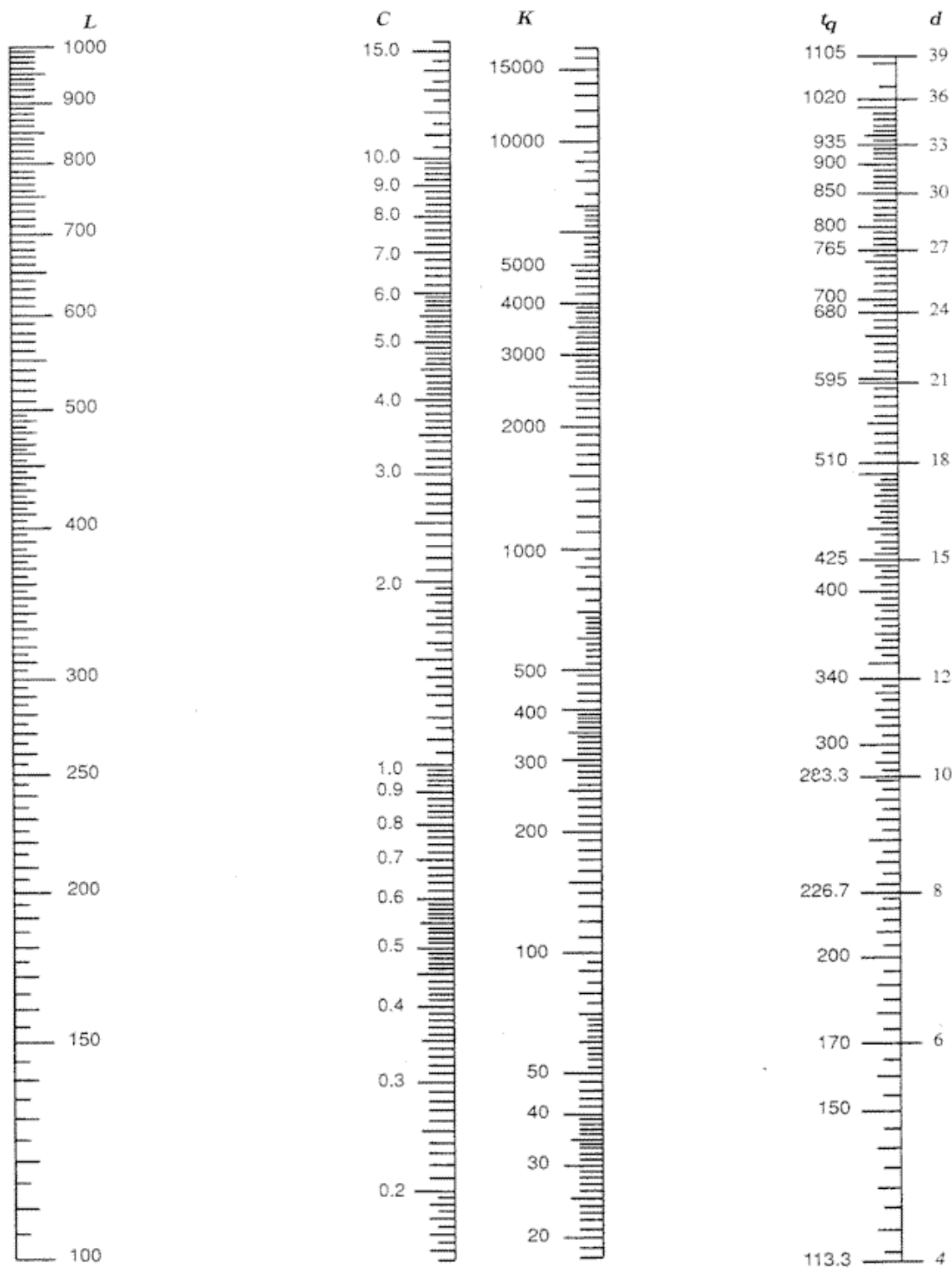
1. Plug all pipe outlets with suitable test plugs. Brace each plug securely.
2. All gauge pressures in the test should be increased by the amount of groundwater pressure at the center of the pipe.
3. Add air slowly to the portion of the pipe installation under test until the internal air pressure is raised to 4.0 psig.
4. After an internal pressure of 4.0 psig is obtained allow at least 2 minutes for air temperature to stabilize, adding only the amount of air required to maintain pressure.
5. After the 2 minute period, disconnect air supply.
6. When pressure has decreased to 3.5 psig, start stop watch. Determine the time in seconds that is required for the internal air pressure to reach 2.5 psig. This time interval should then be compared with the time required by Specification computed as follows.
7. List size and length of all portions of pipe under test in table similar to the one that follows. The maximum reach to be tested in one operation shall be the reach between two consecutive manholes.
8. By the use of Nomograph, compute K and C. Use scales d and L, read K and C, and enter these values in the table.
9. Add all values of K and all values of C for pipe under test.
10. If the total of all C values is less than one, enter the total of all K values into the space for "Time Required by Specification".
11. If the total of all C values is greater than one and less than 1.75, divide the total of all K values by the total of all C values to get t_q .
12. If the total of all C values is greater than 1.75, divide the total of all K values by 1.75 to get "Time Required by Specification" t_q .

Diameter Inches	Length (Feet)	$K = .0111dL$	$C = .0003918 dL$
		Total K _____	Total C _____
		Time required by specification (t_q) _____	

t_q = Time required by specification

d = Diameter of pipe in inches

L = Length of pipe in feet



NOMOGRAPH for the solution of $K = 0.011d^2L$, $C = 0.0003882dL$, $t_q = K \cdot C$

7-17.3(4)F HYDROSTATIC TEST FOR SANITARY SEWER FORCE MAINS

7-17.3(4)F1 GENERAL

All sanitary force mains and appurtenances shall be subjected to hydrostatic pressure testing as soon as possible after they are installed and backfilled.

The hydrostatic pressure tests shall be conducted in accordance with provisions of sections 7-17.3(4)F2 through 7-17.3(4)F8.

7-17.3(4)F2 EQUIPMENT

The Contractor shall furnish the following equipment for the hydrostatic tests:

Amount	Description
2	Approved graduated containers
2	Pressure gauges
1	Hydraulic force pump approved by the Engineer
	Suitable hose and suction pipe as required

Pressure gauges shall be calibrated within 6 months of hydrostatic testing. The Contractor shall provide a Manufacturer's Certificate of Compliance stating the date of calibration of the pressure gauge to be used within 2 Working Days when requested by the Engineer.

7-17.3(4)F3 PROCEDURE

Clean water or approved reclaimed water shall be used as the hydrostatic test fluid. All parts of the piping system shall be subjected to a minimum test pressure of 50 psi plus pressure head required to overcome pumping height.

Where any section of pipe is provided with concrete thrust blocking, do not make the pressure test until at least 5 Days have elapsed after the thrust blocking is installed. If high-early cement is used for thrust blocking, the time may be reduced to no less than 2 days.

The Contractor shall provide all temporary plugs, caps, and thrust blocking and all closure sections and couplings required to test the pipeline in sections at the specified test pressure.

7-17.3(4)F4 DURATION

The duration of each pressure test shall be a minimum of 1 hour. A leakage test of at least 2 hours duration shall immediately follow the pressure test.

7-17.3(4)F5 EXPELLING AIR AND FILLING PIPE

Before applying the specified test pressure, expel all air from the pipe by slowly filling the pipe with water and allow to stand for 48 hours prior to testing.

7-17.3(4)F6 PRESSURE TEST

Test pressures shall be applied by means of a pump connected to the pipe. Apply the test pressure and operate the pump as necessary to maintain the test pressure at its full value for the entire duration of the pressure test.

Before applying the specified test pressure, expel all air from the pipe by slowly filling the section of pipe to be tested with water and allow to stand for 48 hours prior to the start of testing under slight pressure. The duration of each pressure test shall be 1 hour. A leakage test of 2 hours duration shall immediately follow the pressure test.

7-17.3(4)F7 LEAKAGE TEST

For the leakage test, the pump suction shall be in a barrel or similar device or metered so that the quantity of water put into the pipeline can be accurately measured. Apply the test pressure and operate the pump as necessary to maintain the pressure in the pipeline at a minimum of 90 percent of the test pressure for the entire duration of the leakage test. At the end of the test period operate the pump until the test pressure is again attained. Leakage shall be defined as the quantity of makeup water required to maintain the pipeline pressure during the test and to restore the test pressure at the end of the test period. No pipe installation will be accepted if the leakage is greater than the number of gallons per hour as determined by the following formula:

$$L = \frac{ND(P)^{1/2}}{1850}$$

In the above formula:

L =	Allowable leakage, in gallons per hour
N =	Number of joints in the length of pipe tested.
D =	Nominal diameter of pipe, in inches.
P =	Average test pressure during the leakage test, in pounds per square inch gauge.

Should any test of pipe disclose leakage greater than that allowed, locate and repair the defective joints or pipe until the leakage from subsequent testing is within the specified allowance. The Contractor shall submit the method of repair to the Engineer for approval at least 3 Working Days in advance.

7-17.3(4)F8 CORRECTION OF EXCESSIVE LEAKAGE

Should any test of pipe disclose leakage greater than that allowed, locate and repair the defective joints or pipe until the leakage from subsequent testing is within the specified allowance. The Contractor shall submit the method of repair to the Engineer for approval at least 3 Working Days in advance.

7-17.3(4)G PLUGGING EXISTING PIPE

Where indicated on the Drawings, existing pipes shall be plugged on the inlet end as specified in Section 2-02.3(5).

7-17.3(4)H DEFLECTION TEST FOR FLEXIBLE PIPE

For pipes nominally 24-inch and larger inside diameter, deflections shall be determined by a method submitted to and approved by the Engineer. If a mandrel is selected, the minimum diameter, length and other requirements shall conform to the dimensions and requirements in this Specification.

All Sewer and Storm Drain constructed of flexible pipe shall be tested for vertical deflection no less than 30 Days after trench backfill and compaction have been completed. No diameter of the installed pipe shall exceed a tolerance of more than 5 % for 12 inch and smaller nominal diameter pipe, and by no more than 3% for all larger than 12 inch nominal diameter pipe and less than or equal to 30 inch nominal diameter pipe. For pipes less than or equal to 30 inches nominal diameter, a mandrel shall be pulled through the pipe by hand to ensure that the maximum allowable deflection has not been exceeded. Prior to use, the mandrel shall be measured, inspected for roundness, and certified as being sound and accurate. A Manufacturer's Certificate of Compliance stating the mandrel to be used meets these Specifications, shall be submitted to the Engineer at least 1 Working Day prior to the test. The use of an uncertified mandrel or a mandrel altered or modified after certification will invalidate the test, and a 2 Working Day advance notification to the Engineer of a retest with a certified mandrel shall be complied with. If the mandrel fails to pass through the pipe, the pipe will be deemed overdeflected and unacceptable.

Testing shall be conducted on a manhole-to-manhole basis after the line has been thoroughly flushed with water. If testing reveals an overdeflected pipe, it shall be uncovered and, if not damaged from overdeflection or from excavation activities, the pipe may be corrected and reinstalled. If the pipe requires repair, the Contractor shall submit the proposed repair to the Engineer for approval at least 3 Working Days before making the repair. The Contractor shall also provide prior to performing the repair, a Manufacturer's Certificate of Compliance stating that the overdeflected pipe as repaired shall acceptably perform as required by the Specifications. If no repair is recommended, the Contractor shall state that the pipe requires no repair including the reason why the pipe requires no repair, and shall also provide a Manufacturer's Certificate of Compliance stating that the pipe without repair shall acceptably perform as required by the Specifications. Any pipe damaged beyond reasonable repair, due to overdeflection or from any other cause, shall be uncovered and removed from the Project Site and replaced with a new pipe at no cost to the Owner. Pipe large enough for a person to work inside it may be accepted on the basis of direct measurements rather than using a mandrel. The Contractor shall submit a method for making deflection measurements including the measurement device(s), how the measurement device(s) is verified as providing reasonably repeatable results, how "mark points" will be placed on the pipe for the deflection measurements, and how the measurement data at each test location is presented to demonstrate that any indicated deflection is within the tolerances allowed. The Engineer reserves the right to determine the number of measurements and the orientations of each measurement at each test location. The minimum number of orientations per test location shall be 3 in equal angle projections (3 orientations at 0°, 60°, and 120°). The Engineer also reserves the right to determine the number of test locations. The minimum number of test locations on any single section of pipe shall be no less than 2, and in no case shall there be less than 3 pipe sections tested, and no less than 3 pipe sections tested per any 100 foot length of pipeline.

The mandrel shall:

1. Be a rigid, nonadjustable, odd-numbering-leg (9 legs minimum) mandrel having an effective length not less than its nominal diameter;
2. Have a minimum diameter at any point along the full length as follows:

Minimum Mandrel Diameter (inches)	Pipe Material	Nominal Size (Inches)
5.619	PVC ASTM D 3034 (SDR 35)	6
7.524		8
9.40		10
11.91		12
13.849		15
16.924	PVC ASTM F 679 (T-1 Wall)	18
19.952		21
22.246		24
25.29		26
28.502		30

3. Be fabricated of steel, be fitted with pulling rings at each end, be stamped or engraved on some segment other than a runner indicating the pipe Material, Material specification, nominal pipe size, and mandrel OD (e.g., PVC, ASTM D 3034, 8 inch, 7.524 inch); and be furnished in a suitable carrying case labeled with the same data as stamped or engraved on the mandrel.

7-17.3(4)I TELEVISION INSPECTION WITH AUDIO ASSESSMENT

Once during the final inspection process and after all manholes have been rechanneled, the Contractor in the presence of the Engineer, shall television inspect the interior of all mainline Sewer and Storm Drain pipe 6 inches through 48 inches in diameter to determine acceptance of this portion of the Work. Pipe larger than 48 inches in diameter will be inspected visually by the Engineer after cleaning and successful testing by the Contractor. Side Sewer, catch basin and inlet connection pipe, and other non-mainline pipe will not require television inspection.

Personnel Qualifications: Personnel performing television inspection shall have completed the Pipeline Assessment and Certification Program (PACP), and shall have adequate experience and working knowledge of the entire television inspection systems and processes. Contractor shall submit said certification to the Engineer at least 3 Working Days in advance of the first television inspection.

Camera Equipment: The camera shall be a 360-degree radial view color television camera (also known as "pan and tilt") with a mechanical footage counter calibrated to indicate video footage consistent with distance traveled in the pipe. Footage shall be zeroed at centerline structure (manhole, vault, etc.) where the video begins and footage shall increase as it travels forward, and decrease when backward camera movement is required. Footage shall be displayed on the video recording and be mentioned on the audio portion (see "audio commentary on recording").

Light Source: The camera shall have a light source providing adequate illumination to clearly identify invert, crown, joints, sides, connections, infiltration/exfiltration, and as may be necessary. Illumination shall be capable of providing adequate illumination to at least 15 feet in front of the light.

Camera travel in the pipe: The camera shall travel along the invert of the pipe invert to provide the best view of the crown, invert, connections and sides of the pipe, and shall travel at a speed no faster than 30 feet per minute.

Audio commentary on recording: Commentary shall be objective and shall be based on PACP defined assessment conditions. Audio shall be intelligible and shall be as free from interference and background noise as can reasonably be done. Subjective comment (such as "the fault of", "caused by", and opinion, etc.) shall not be used. Comment shall include the footage location of the comment. At each of connections, the beginning structure, the ending structure, indicated flaws, areas of infiltration/exfiltration, open joints, outfall, and at other features as may be necessary, the footage location shall be mentioned on the audio.

Required Labeling on recording and in audio commentary: Each recording shall have audio accompaniment and shall address a single run of pipe between two (2) structures (manholes, vaults, or ending in an outfall, etc.) on a single recording. Where relatively short runs exist (defined as 100 or fewer feet between centerlines of structures, or to end of outfall), more than one run may be allowed on a single recording when approved by the Engineer at least 3 Working Days in advance. The recording shall contain a legible label that clearly states the following, and the audio commentary shall begin with the following:

- a. Date and time of day television inspection performed;
- b. Names of television inspection crew members;
- c. Project name, vault plan number listed on Drawings, and Drawing sheet number;
- d. Location with structure labels (for example – manhole 25, vault 2, outfall, etc.), camera travel direction, size of pipe, pipe material (such as "Broad Street, 5th Ave west to midblock, manholes 24 to 25, going downstream, 24 inch reinforced concrete pipe"); and
- e. a unique identification number, with these numbers being in consecutive sequence on all videotapes of project pipe.

If more than one run is on a recording, such information shall clearly be shown on the label and stated on the audio accompaniment.

Recording quality and characteristics: Television inspections shall be on compact discs (CD). If CD not possible or compatible with camera equipment or system, then a Standard Grade, 60-minute VHS tapes taped at SP speed, shall be of a quality that completely and clearly shows that listed in "required extra inspection".

Recordings not meeting the requirements of this Specification will be determined to be defective work. Upon written notice by the Engineer, the Contractor shall promptly conduct a second television inspection meeting specified requirements, and shall submit a second recording at no additional or separate cost to the Owner.

Required Pre-Notification: The Contractor shall notify the Engineer at least 3 Working Days in advance of the first television inspection.

Pre television inspection preparation: Unless the Contract specifies otherwise, the pipeline system to be inspected shall be successfully pressure tested and then flushed clean prior to beginning inspection. Television inspection shall be performed prior to allowing mainline flow into the pipe from upstream sources. Upstream bypass, when used, shall accommodate television inspection to afford full visibility of pipe inverts (see Section 7-17.3(2)K).

Required Extra Inspection: At all lateral connections, areas of indicated infiltration/exfiltration, open joints, indicated pipe deflection, defects of any kind, and as the Engineer may require, shall require the camera to slow down and fully focus on such areas including having the camera slowly travel backward and forward for multi-directional views. Said areas shall require focused video inspection of not less than 5 seconds. Cameras with telescoping ability shall view the area by telescoping in and out as appropriate for the Engineer to evaluate the condition with certainty.

Reinspection: Should television inspection reveal defective work, the Contractor shall, upon written notice from the Engineer, correct said defects. An additional television inspection ("reinspection") shall then be taken of the corrected pipe run to verify the corrected pipe meets Specifications. Such reinspection shall be considered in accordance with Section 1-05.7.

Reverse travel runs: The Engineer may require a second television inspection including audio accompaniment run along a pipe by having the camera travel in the direction opposite the previous inspection ("reverse direction"). Such reverse inspection shall be on the same video tape with the footage counter beginning at the upper number and as the camera travels, decreasing in footage count. The audio portion shall include at the beginning of this reverse run, a statement to the effect that "a second view is about to begin of the same length of pipe in the reverse direction".

Temporary breakdowns: Should an occurrence such as camera breakdown or inability to perform as specified, or other condition arise where no camera or television or audio progress can be made, after the initial 30 seconds of such condition, the operator shall make comment on the audio of such condition and the footage location, then shall shut down the camera and the

audio. Upon fixing such a condition, the video and audio shall be restarted and the audio shall include a comment to the effect "_____ condition fixed and video and audio restarting at _____ footage location".

Contractor to provide: Compact disc shall be furnished to the Engineer within 10 Working Days of each television inspection, and shall become the property of the Engineer. The Engineer may agree to other arrangements.

Additional television inspection: Six to eleven months after the Physical Completion Date, the pipes may, at the option of the Engineer, be television inspected again. Videotaping may be done by Owner's forces or, at the Engineer's option, by the Contractor. The Contractor shall schedule such inspection within 10 Working Days after the date of written notice by the Engineer. The audio portion on this recording shall indicate the same information as specified in Required Labeling on recording and in audio commentary also stating "this is an additional television inspection". This additional inspection will then be compared with the prior recording to determine whether or not any change has occurred in the condition of the pipe. Should there be evidence of changed conditions that warrant correction, the Contractor shall, upon written notice of the Engineer, correct those defects pursuant to Section 1-05.10. After the necessary corrections have been made by the Contractor, the corrections shall be verified in compliance with the Contract at the Contractor's sole expense.

Pipes that are submerged: New pipe that is submerged (for example – Storm Drain that outfalls below the surface of a body of water), do not require television inspection, unless the Contract specifies otherwise.

7-17.4 MEASUREMENT

Bid items of Work completed pursuant to the Contract will be measured as provided in Section 1-09.1, Measurement of Quantities, unless otherwise provided for by individual measurement paragraphs herein this Section.

Measurement for "Extra Excavation" will be by the cubic yard of Material actually removed beyond the standard trench neat lines shown on Standard Plan nos. 284 and 285.

Measurement for "Bedding, (Class), (Size) Pipe" and for "Bedding, CDF, (Size) Pipe" for Sewer, Culvert, and Storm Drain as shown on Standard Plan no. 285, and for Water Main as shown on Standard Plan no. 350, will be by the linear foot of pipe actually installed. For Sewer and Storm Drain, measurement will be from center to center of standard manholes or to the inside face of other Structures. For Water Main, measurement will be to inside face of Structure, to end of pipe, or to centerline of connecting tee. Class D bedding will not be measured. Bedding beyond neatlines shown on the Standard Plans will not be measured.

Measurements for "Pipe, (Use), (Material), (Class), (Size)", for "Steel Casing Pipe, (Class), (Size), (Underground Construction Method)", and for "Pipe, (Material), (Class), (Size), (Underground Construction Method)" for other than directional drilling will be by the linear foot of pipe actually installed and successfully tested, and shall be along the centerline of the pipe through the tees or wyes with the exception of pipe ending at a tee or wye. Measurements will be to the center of new manhole or rechanneled existing manhole; or to the inside face of Structure or existing manhole not rechanneled; or to the end of pipe where it meets a manhole stub; or to a wye, or to a tee whether with stub or cut-in. Measurement will be to the nearest 0.1 foot. See Standard Plan no. 010. All incidental to Sewer and Storm Drain pipe measurement will be measured within Standard Plan no. 284 neatlines, and for Water Main will be measured within Standard Plan no. 350 neatlines.

No measurement will be made for trench excavation, trench backfill, and selected Material for trench backfill, except for foundation Material, for extra excavation, and for non-native and non select backfill Material including CDF.

Measurement for foundation Material will be by the cubic yard of Mineral Aggregate required to fill the void made by extra excavation and shall be based on neat line width of trench and depth and length as computed by the Engineer.

Measurement for "Mineral Aggregate, (Type)" and for "Controlled Density Fill" trench backfill will be by the cubic yard based upon the neat line trench pay width as specified in Section 7-17.3(1) and the Standard Plan, or other neatline dimensions when designated by the Engineer. Imported Mineral Aggregate and CDF used beyond these neat line limits shall be at the Contractor's sole expense.

Measurement for "Safety Systems in Trench Excavation, Minimum Bid = \$0.40 per Square Foot" and for "Support System" will be by the square foot. The square foot quantity equals the area of a vertical plane through the pipe centerline, calculated by multiplying the average of the trench end depths by the length of trench between points four or more feet deep. Depth is measured from existing surface grade at the time of excavation to pipe invert. No measurement will be made for support system beyond designated locations indicated in the Contract where the Contractor determines a support system is required. See Section 2-09.4 for measurement of a trench safety system where a trench is created in a structural excavation.

Measurement for "TV Inspection" will be for the linear feet of installed 6" - 48" diameter mainline pipe videotaped once during (1) final inspection and (2) such re-videotaping done six to eleven months after the Physical Completion Date. Measurement will be made along the pipe centerline through tees from (1) center to center of new or rechanneled manholes, or (2) to the inside face of Structures or manholes not channeled, or (3) to the end of pipe where it dead ends beyond manholes.

Measurement for "Clay Dam, (Size) Pipe" will be per each.

Measurement for "Tee, (Material), (Size)" will be per each where "size" applies to the size of the pipe fitting into the tee branching off the mainline pipe as shown on Standard Plan no. 010, and "Material" is the Material of the mainline pipe with the branching tee.

Measurement for "Controlled Density Fill" will be by the cubic yard of material actually placed for pipe bedding or trench backfill.

Measurement for "Dam, Clay Trench" will be per each.

7-17.5 PAYMENT

Compensation for the cost necessary to complete the work described in Section 7-17 will be made at the Bid item prices Bid only for the Bid items listed or referenced as follows:

1. **"Extra Excavation"**, per cubic yard.

The Bid item price for "Extra Excavation" shall include all costs for the work required to remove; haul and dispose of the excavated material.

2. **"Bedding, (Class), (Size) Pipe" and "Bedding, CDF, (Size) Pipe"**, per linear foot.

The Bid item price for "Bedding, (Class), (Size) Pipe" and for "Bedding, CDF, (Size) Pipe" shall include all costs for the work required to furnish and install bedding. Cost of Class D bedding shall be included in the Bid item for the pipe Bid item and therefore no separate or additional payment will be made for Class D bedding.

3. **"Pipe, (Use), (Material), (Class), (Size)"**, per linear foot.

The Bid item price for "Pipe, (Use), (Material), (Class), (Size)" shall include all costs for the work required to furnish and install the pipe of the type and size specified, and including the following:

- a. trench excavation (except "Extra Excavation"); haul, stockpile, backfill, and compact suitable native Material backfill,
- b. handling; hauling, storage, removal; off-site disposal of excess suitable and unsuitable excavated native material, or hauling, storage, placement of suitable excess excavated native material or selected Material elsewhere on the project except where designated for embankment construction,
- c. dewatering of the trench,
- d. required trench excavation, backfill, and compaction,
- e. cleaning and testing per Section 7-17.3(4),
- f. Class D bedding,
- g. pipe coupling, and
- h. removal and disposal of existing pipe within trench neatline limits when pipe replacement is called for in the Contract.

All costs in connection with excavating test pits and for standby time during field density tests for compaction shall be considered as included in the Bid item prices for the applicable pipe Bid items.

Unauthorized excavation below the established trench grade shall be made good by the Contractor at the sole expense of the Contractor by providing, placing and compacting suitable bedding Material to the proper grade elevation.

The work of cleaning and testing, except TV inspection, and furnishing caps and plugs for the tests shall be considered as included in the Bid item prices of the pipe Bid items.

Costs for the work required in proof testing the pipe shall be considered included in the Bid item prices for the appropriate pipe Bid items.

Any damage resulting from testing of the Sewers and appurtenances specified in Section 7-17.3(4)A shall be made good by the Contractor at the Contractor's sole expense.

All costs of determining the source or sources of leakage and the cost to repair or replace the Sewer found defective as specified in Section 7-17.3(4), shall be borne by the Contractor in accordance with Section 1-05.7.

If the pipe fails the deflection test as specified in Section 7-17.3(4)H, all costs to locate and repair the failed sections and retest the pipe shall be borne by the Contractor in accordance with Section 1-05.7.

All costs for the work required to furnish and install joint coupling devices as specified in Section 7-17.3(2)F shall be considered as included in the Bid item prices for the pipe Bid items.

4. **"Casing Pipe, (Material), (Class), (Size), (Underground Construction Method)"**, per linear foot.

The Bid item price for "Casing Pipe, (Material), (Class), (Size), (Underground Construction Method)" for other than directional drilling shall include all costs for the work required to furnish and install casing pipe as specified in Section 7-17.3(2)J, including installation and removal of shoring of the jacking pit. All cost for filling the annular space when required in the Contract shall be incidental to this Bid item and no separate or additional payment will be made therefore.

Payment for directional drilling installation will be as specified in Section 7-22.5.

5. **"Pipe, (Material), (Class), (Size), (Underground Construction Method)"**, per linear foot.

The Bid item price for "Pipe, (Material), (Class), (Size), (Underground Construction Method)" for other than directional drilling shall include all costs for the work required to furnish and install the pipe as specified in Section 7-17.3(2)J.

Payment for directional drilling installation will be as specified in Section 7-22.5.

6. **"Tee, (Material), (Size)"**, each.

The Bid item price for "Tee, (Material), (Size)" shall include all costs for the work required to furnish and install the tee including plug when required.

7. **"Tee, (Size), Cut-In Existing (Material) Pipe"**, each.

The Bid item price for "Tee, (Size), Cut-In Existing (Material) Pipe" shall include all costs for the work required to furnish and install the tee as specified in Section 7-17.3(2)C3. If Drainage and Wastewater Utility installs a pipe with a tee, no payment will be made.

8. **"Safety Systems in Trench Excavation, Minimum Bid = \$0.40 per Square Foot"**.

The minimum Bid item price for "Safety Systems in Trench Excavation, Minimum Bid = \$0.40 per Square Foot" shall be forty cents (\$0.40) per square foot. Should the Contractor determine that the cost for this work is greater than \$0.40 per square foot, the Contractor may Bid a higher Bid item price by crossing out the minimum Bid item price and extension shown in the Bid Form, writing in a higher Bid item price and extension in the Bid Form, and initialing the change. Should a Contractor write in a Bid item price less than the minimum \$0.40 per square foot, the \$0.40 Bid item price shall govern and become a part of the Bid.

The Bid item price for "Safety Systems in Trench Excavation, Minimum Bid = \$0.40 per Square Foot" shall include all costs for the work required to provide, construct, maintain and remove safety systems for trench excavations equal to or exceeding a depth of 4 feet as specified in Section 7-17.3(1)A7a. All costs for support system beyond the designated locations in the Contract where a support system may be required as determined by the Contractor shall be included in the Bid item price for the Bid item "Safety Systems in Trench Excavation, Minimum Bid = \$0.40 per Square Foot".

9. **"Temporary Sewer Bypass"**, per lump sum.

The Bid item price for "Temporary Sewer Bypass" shall include all the work required to bypass Sewer flow around the construction work.

10. **"Television Inspection"**, per linear foot.

The Bid item price for "Television Inspection" shall include all costs for the work required for CCTV inspection of all Sewer and Storm Drain pipe 6" through and including 48" diameter and furnishing an acceptable videotape of a Sewer or Storm Drain pipe to the Engineer. Payment will be for one complete videotaping session made during (1) the final inspection process and (2) one complete re-videotaping, if videotaping is requested by the Engineer, six to eleven months after the Physical Completion Date. Costs for additional videotaping sessions and tapes necessary to verify corrections or replacement of pipe or done solely for the Contractor's convenience shall be borne by the Contractor.

11. **"Support System"**, per square foot.

The Bid item price for "Support System" shall include all costs for the work required to furnish, install, maintain, and remove the support system for trench excavations at the designated locations on the Drawings as specified in Section 7-17.3(1)A7b. No separate or additional payment for "Support System" will be made for the use of support system as part of the Contractor determined trench safety system outside of the locations specified on the Drawings and all costs for such support system shall be included in the Bid item price for the Bid item "Safety Systems in Trench Excavation, Minimum Bid = \$0.40 per Square Foot".

12. **"Clay Dam, (Size) Pipe"**, per each.

The Bid item price for "Clay Dam, (Size) Pipe" shall include all costs for the work necessary to excavate, handle spoils as specified in item 3b this Section, furnish and install the clay dam.

13. **"Backfill, CDF, (Size) Pipe"**, per cubic yard.

The Bid item price for "Backfill, CDF, (Size) Pipe" shall include all costs for the work necessary to furnish and place the specified backfill.

14. **"Controlled Density Fill"**, per cubic yard.

The Bid item price for "Controlled Density Fill" shall include all costs for the work required to furnish and place the CDF as specified.

15. **"Dam, Clay Trench"**, per each.

The Bid item price for "Dam, Clay Trench" shall include all costs for the work required to furnish and install the clay dam as specified.

16. **Other payment information.**

See Section 2-09.5 for payment of a trench safety system where trench is created in a structural excavation.

Where unauthorized excavation has been made which increases the established trench depth beyond 4 feet, the Contractor shall meet the requirements specified for Trench Safety Systems in Section 7-17.3(1)A7a at no additional cost to the Owner.

Payment for imported Material when ordered in lieu of native backfill Material by the Engineer will be paid as "Mineral Aggregate, (Type)", or other imported Material acceptable to the Engineer.

Foundation Material when required will be paid as "Mineral Aggregate, (Type)" per cubic yard, per Section 4-01.5.

Where the Engineer determines that the existing foundation is unsuitable, and foundation Material specified by the Engineer is not in the Contract and no Bid item for "Mineral Aggregate, (Type)" is included in the Bid Form, payment will be made in accordance with Section 1-04.1(2).

The cost for the Owner's labor and equipment for the videotaping during the final acceptance process and the videotaping 6 to 11 months later to recheck the pipe condition will be borne by the Owner unless additional videotape inspection is necessary to verify corrections or replacement of deficient pipe. The cost of additional television inspection, and cleaning in preparation for television inspection, to verify repairs or replaced pipe shall be borne by the Contractor. The Contractor shall also be responsible for all costs incurred in any television inspection performed solely for the benefit of the Contractor.

If the Contractor calls for an initial TV inspection, and the pipe is not clean or has so many deficiencies that the line cannot be fully inspected, the reinspection will be charged to the Contractor, and the cost withheld from money due to the Contractor.

The Contractor shall provide all necessary water for construction and testing purposes (see Section 2-07).

No separate or additional compensation will be made for submittals, or for Material used in the jacking operations or for the cost of the backfilling operations, including compaction.

Payment for plugging pipes will be in accordance with Section 2-02.5.

Payment for selected Material used for embankment compaction will be in accordance with Section 2-03.5.

The Contractor shall, at the Contractor's sole expense, provide pipe of increased strength classification or place a class of bedding of higher load bearing capacity, as required by the Engineer, when the maximum trench width specified in Section 7-17.3(1)A1 is exceeded by the Contractor without prior written approval of the Engineer. The Contractor shall furnish and install any approved imported backfill Material required outside the trench neat line limits.

SECTION 7-18 SIDE SEWERS

7-18.1 DESCRIPTION

Section 7-18 describes work consisting of locating and placing side Sewer, locating tees, and testing of side Sewer. This Section also accommodates private construction in the Right of Way under permit by DPD and SDOT Street Use.

In the Right of Way, a side Sewer, with a capital "S" in "Sewer" as defined in Standard Specification Section 1-01.3, is considered to be that portion of pipe that is constructed between a main Sewer or Storm Drain and the Right of Way margin and shall be constructed in compliance with this Section 7-18 as is reflected by Title 21 of the Seattle Municipal Code. All privately owned and operated drainage control facilities or service drain system, whether or not they discharge to a public drainage control system, Sewer, combined Sewer, or Storm Drain, shall be considered side Sewer where in the Right of Way. Side Sewer does not include any pipe not in the Right of Way and does not include internal building piping or connecting appurtenances, the installation of which is controlled by Seattle Municipal Code, ordinance or regulation.

In property not within Seattle's Right of Way, the term "side sewer", with no capital "s" in "sewer", shall be interpreted as pipe labeled as "side sewer" or "service drain" or "combined side sewer" as addressed in Title 21 Seattle Municipal Code and applicable Director's Rules.

7-18.2 MATERIALS

Materials for side Sewer shall meet the requirements of the following Sections:

Pipe	9-05
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Side Sewer in Right Of Way shall be not less than 6 inches in side diameter unless otherwise specified in the Contract.

All pipe shall be clearly marked with type, class, date of manufacture, location of manufacturing plant, and/or thickness, as applicable. Marking shall be legible and permanent on the outside surface of the pipe, and shall be able to withstand normal wear due to handling and storage.

Approved jointing shall be flexible gasketing. Flexible gasketing shall be construed to include rubber, synthetic rubberlike and plastic Materials specially manufactured for the joint, pipe size, and use intended and shall be furnished by the manufacturer of the pipe to be used.

Mortared joints will not be allowed.

Tees, wyes, couplers, and adapters shall conform to the requirements of this Section.

Bends, and transition sections shall be as specified in the Contract.

Couplings for dissimilar pipe shall be flexible gaskets with stainless steel shielding to provide shear control.

Side Sewer that may be exposed to hot sewage, steam, or other extreme exposure shall be of a Material and with joints as specified in the Contract, and shall meet the clearance requirements specified in Section 1-07.17(2).

7-18.3 CONSTRUCTION REQUIREMENTS

7-18.3(1) SIDE SEWER CONSTRUCTION

7-18.3(1)A GENERAL

Trench excavation shall comply with the requirements of Section 7-17.3(1)A and trench excavation over 4 feet in depth shall comply with the trench safety requirements of Section 7-17.3(1)A7a.

Side Sewer work shall be performed by a registered side sewer contractor (RSSC) in accordance with SMC 21.16.060.

The Contractor or Subcontractor performing side Sewer work shall be an RSSC.

Where Section 7-18 does not address specific construction requirements, the construction requirements for Sewer in Section 7-17 of these Standard Specifications shall apply.

Side Sewer location shown on the Drawings shall be subject to relocation in the field after construction starts to accommodate site specific conditions. Regardless of the Drawing location, the Contractor shall place the tee or wye branch in the main Sewer or Storm Drain at the location designated by the Engineer.

When the Work requires, the Engineer will stake and indicate the depth for the invert elevation of side Sewer at the Right-of-Way margin.

Side Sewer shall be installed with existing, or with other project proposed, Water Main and other underground facilities, in accordance with the clearance requirements specified in Section 1-07.17(2) and other code, law, and regulation.

7-18.3(1)B RESERVED

7-18.3(1)C SIDE SEWERS SHOWN ON THE DRAWINGS

7-18.3(1)C1 PROTECTION OF EXISTING SIDE SEWER

See Section 1-07.16.

7-18.3(1)C2 REMOVE AND REPLACE EXISTING SIDE SEWER

When the Drawings call for removal and replacement of existing side Sewer, only new pipe shall be used to replace the removed pipe.

7-18.3(2) EXCAVATION, FOUNDATION PREPARATION, BEDDING, AND BACKFILL

Excavation, foundation preparation, bedding and backfill for side Sewer shall conform to the requirements of Section 7-17, except that bedding or backfill shall be limited to that required to hold the pipe in true alignment and to grade without covering the pipe. The Contractor shall give the Engineer at least 2 Working Days advance notice for inspection and testing per Section 7-18.3(6) before covering the side Sewer.

7-18.3(3) PIPE INSTALLATION AND JOINTING

7-18.3(3)A GENERAL

Pipe installation and jointing, except as hereinafter provided, shall conform to the requirements of Section 7-17 and Chapter 21.16 of the Seattle Municipal Code.

7-18.3(3)B LINE AND GRADE

Side Sewer shall be installed to a line and grade between the main Sewer or Storm Drain tee branch or wye branch, and the Right of Way margin, so as to best serve the property relative to the following conditions, as approved by the Engineer:

1. Where a vacant property is level with or lower than the street grade, the invert elevation of the proposed side Sewer at the Right of Way margin shall be 1 foot higher than the elevation of the crown of the main Sewer or Storm Drain at the location of its tee or wye branch connection. See Standard Plan no. 283 for additional requirements.
2. Where an occupied property is situated at higher elevation than the street grade and where the slope of the proposed side Sewer is steeper than 50%, the maximum elevation of the side Sewer at the Right of Way margin will be established by the Engineer with due consideration for placing the side Sewer below the invert of any proposed Storm Drain pipe, unless conditions require otherwise. The clearance between the invert of an existing Storm Drain or Sewer and the crown of a side Sewer below it shall be not less than 6 inches. In either of these conditions, the end of the side Sewer at the Right of Way margin shall be placed deep enough to accommodate at least 2-1/2 vertical feet of compacted backfill between the crown of the pipe and finished grade at that point.
3. Where an occupied property is level with or lower than the street grade, side Sewer pipe shall be installed on a grade not less than 2%.

7-18.3(3)C PIPE INSTALLATION

Bell and spigot pipe shall be installed with the bell end facing up grade. All pipe installation shall start and proceed up grade from the point of connection at the Sewer or Storm Drain or other starting point.

Between fittings, pipe shall be installed in a straight line at a uniform grade.

7-18.3(3)D JOINTING – NEW PIPE TO EXISTING PIPE

Where it is necessary to break out an existing side Sewer during construction due to grade conflict with a newly constructed pipeline, only new pipe shall be used in reconnecting the side Sewer. Where joints cannot be made due to dissimilar pipe Material or mismatched wall thickness, the Contractor shall use a flexible gasketed coupling to make a watertight joint. **Couplings shall have flexible gaskets and stainless steel shielding.**

7-18.3(4) FITTINGS

All fittings shall be factory-produced and shall be designed for installation on the pipe to be used.

The maximum deflection permissible at any one fitting or joint shall not exceed the pipe manufacturer's recommendation, and in no case shall the deflection exceed 2 inches per foot at any joint or fitting. The maximum deflection of any combination of two adjacent fittings or joints shall not exceed 45 degrees (one-eighth bend). Should greater than 45 degree deflection be needed between adjacent joints or fittings, a straight pipe of not less than 2-1/2 feet in length shall be installed between such adjacent fittings or joints, unless either one of such fittings is a wye branch with a cleanout provided on the straight leg or such a wye branch fitting is substituted for a joint.

Side Sewer shall be connected to the tee or wye provided at the main Sewer or Storm Drain where such is available, utilizing approved fittings or adapters. Where no tee or wye is provided or available, connection shall be made by core drilling and installing an approved insert or saddle tee as specified in Section 7-17.3(2)C3. The installation of side sewer to a vertical connection at the main Sewer or Storm Drain shall be as shown on Standard Plan no. 234.

7-18.3(5) CLEANOUTS

Refer to Section 7-19.

7-18.3(6) INSPECTION AND TESTING**7-18.3(6)A INSPECTION**

As specified in Section 7-18.3(2) side Sewer covered without Engineer inspection shall be uncovered for inspection inspection.

7-18.3(6)B TESTING

All newly installed side Sewer shall be tested after backfill. Side Sewer that is reconstructed or repaired to a length of 10 feet or more shall be tested for watertightness in accordance with Section 7-17.3(4)B. The only exceptions for no testing required shall be:

1. a new reconstruction of side Sewer consisting of a single length of pipe, and
2. existing side Sewer reconnected to the Sewer or Storm Drain.

Testing shall be performed in the presence of the Engineer in accordance with Section 7-17.3(4).

All side Sewer constructed in conjunction with main Sewer or Storm Drain construction, for purposes of testing as specified in Section 7-17.3(4), shall have a 6-inch tee fitting placed at the point where the side Sewer crosses the Right of Way margin as shown on Standard Plan no. 283. The tee opening shall be positioned perpendicular to the side Sewer slope.

When the new side Sewer is connected to a new main Sewer or Storm Drain installed under the same Contract, and the side Sewer is not tested simultaneously with the test of the main Sewer or Storm Drain, the Contractor shall furnish and place an additional 6-inch tee in the first length of pipe out of the tee on the main Sewer or Storm Drain so that an inflatable rubber ball can be inserted for sealing off the side Sewer and thus permit separate side Sewer and mainline tests.

When the new side Sewer is connected to an existing main Sewer or Storm Drain, the Contractor shall furnish and place 2 test tees as shown on Standard Plan no. 283 and as follows:

- a) one immediately adjacent to the main Sewer or Storm Drain, and
- b) a second at the Right of Way margin.

The ends of side Sewer and test tee openings shall be plugged watertight with Materials and by method acceptable to the Engineer.

Side Sewer installed with pipe extending beyond the Right of Way margin that includes other connection, such as runoff or downspout, and is associated with private construction under the inspection of DPD, shall not be part of the Contract, and may require testing of the entire side sewer system including pipe in the Right of Way.

7-18.3(7) MISCELLANEOUS REQUIREMENTS**7-18.3(7)A PIPE AND CONNECTIONS – PRIVATE PROPERTY**

Side Sewer in utility easement shall not be less than 6 inch inside diameter. Side Sewer and/or service drain on private property shall be not less than 4 inches inside diameter. No roof drain, area drain, or subsurface drain shall be connected to a side Sewer which is connected to a separate main line sanitary only Sewer.

Private property roof drains or service drains in areas of mainline combined Sewer shall be run in a separate pipe (not combined with sewage) to the property line before connecting into the side Sewer.

7-18.3(7)B PROXIMITY TO OTHER UNDERGROUND FACILITIES

In private property, clearance between side sewer and/or service drain and water supply lines shall comply with WSDOH requirements and other applicable code and regulation.

In the Right of Way, side Sewer clearances shall be as specified in Section 1-07.17(2).

7-18.3(7)C PLUGS

In the Right of Way, unused side Sewer openings shall be securely sealed with a watertight plug fastened in place, as approved by the Engineer.

The only exception is private construction under permit from DPD and SDOT Street Use where unused side sewer openings in private property and side Sewer openings in the Right of Way, shall be closed with a watertight plug fastened in place as approved by DPD.

7-18.3(7)D SEPTIC TANKS AND CESSPOOLS – PRIVATE PROPERTY

No side sewer shall be constructed through or adjacent to an existing cesspool or septic tank. If site conditions prohibit any other location, the Contractor shall abate the cesspool or septic tank by such means as the DPD inspector may direct

7-18.3(8) RESTORATION, FINISHING, AND CLEANUP – PRIVATE CONSTRUCTION

Restoration, finishing, and cleanup due to private construction in Seattle's street Right of Way under Street Use permit and DPD permit, shall comply with the Street and Sidewalk Pavement Opening and Restoration Rules.

7-18.3(9) EXTENDING SIDE SEWERSIDE SEWER INTO PRIVATE PROPERTY

Extending side Sewer into private property shall not be part of the Contract and no such work will be allowed.

Unless authorized by Section 21.16 of the Seattle Municipal Code, private property owners who wish to extend side sewer into the Right of Way or connect with Sewer or Storm Drain, shall do so under permit with DPD and SDOT Street Use.

7-18.3(10) END PIPE MARKER

At the Right of Way margin, a 4 foot long 2-inch x 4-inch stake shall be buried to a 3 foot depth directly over the side Sewer. The exposed 1 foot of stake shall be painted traffic white, and the depth to the invert of the side Sewer from finish grade shall be painted legibly and with black permanent ink or other durable marking agent, on the exposed white portion of stake. The bottom of the stake shall have a 2-inch x 4-inch cleat securely nailed to the stake to prevent withdrawal of the buried stake. In addition, a 12 gauge galvanized wire shall be attached to the tee on the side Sewer, or to the plugged end of the side Sewer if no tee, and shall extend to 6 inches above finished grade at the stake and not attached to the stake.

7-18.4 MEASUREMENT

Bid items of Work completed pursuant to the Contract will be measured as provided in Section 1-09.1, Measurement of Quantities, unless otherwise provided for by individual measurement paragraphs herein this Section.

Measurement for "Pipe, (Use), (Material), (Class), (Size)" will be to the nearest 0.10 foot along the pipe from the tee or wye of the main Sewer or Storm Drain through tees, wyes and other fittings to the Right of Way margin as shown on Standard Plan no. 010, or to the end of pipe when the Contract or Engineer requires.

Measurement for "Tee, Test, (Material), (Size)" shall be per each.

Measurement for trench safety system will be in accordance with Section 7-17.4.

7-18.5 PAYMENT

Compensation for the cost necessary to complete the work described in Section 7-18 will be made at the Bid item prices Bid only for the Bid items listed or referenced as follows:

1. **"Pipe, (Use), (Material), (Class), (Size)", per linear foot.**

The Bid item price for "Pipe, (Use), (Material), (Class), (Size)", shall include all costs for the work required to furnish all Material and Supplies necessary to install the side Sewer pipe of the type specified, including, but not limited to, the following:

- a. trench excavation (except "Extra Excavation"), haul, stockpiling, backfill and compaction of suitable native Material;
- b. removal and disposal of excess and/or unsuitable excavated native Material;
- c. dewatering of the trench;
- d. removal and disposal of existing side Sewer pipe encountered in required trench excavation and backfill;
- e. temporary bypass of sewage, including pumping;
- f. cleaning and testing;
- g. end pipe marker, plug, balloon; and
- h. Class D Bedding.

2. **"Tee, Test, (Material), (Size)", per each.**

The Bid item price for "Tee, Test, (Material), (Size)" shall include all costs for the work required to furnish, install, and remove as necessary the test tee.

3. **Other payment information.**

Payment for "Safety Systems in Trench Excavation, Min. Bid = \$0.80 per Square Foot", for "Extra Excavation", for "Mineral Aggregate (Type)", for "Tee, (Material), (Size)", for "Clay Dam", for "Backfill, CDF, (Size) Pipe", for "Bedding, CDF, (Size) Pipe", and for "Bedding, (Class), (Size) Pipe" will be in accordance with Section 7-17.5.

All cost associated with uncovering a side Sewer without Engineer inspection and all cost associated with re-constructing any portion of completed Work associated with the uncovering shall be at the Contractor's sole expense and no separate or additional payment will be made therefore.

Remove and re-install side Sewer will be paid as "Pipe, (Use), (Material), (Class), (Size)".

No payment will be made for any expense associated with the Contractor installing an additional tee on the side Sewer and requiring separate tests for purposes of testing as specified in Section 7-18.3(6)B.

All costs relating to construction in private property, and to private construction in Seattle's Right of Way under the jurisdiction of DPD and SDOT Street Use, shall not be part of the Contract and no separate or additional payment will be made therefore.

SECTION 7-19 SEWER CLEANOUT

7-19.1 DESCRIPTION

Section 7-19 describes work consisting of the construction of sanitary Sewer cleanouts in accordance with Standard Plan no. 280 and as indicated in the Contract.

7-19.2 MATERIALS

All Materials incorporated into the total cleanout structure shall meet the requirements of the various applicable Sections of these Standard Specifications.

7-19.3 CONSTRUCTION REQUIREMENTS

A cleanout shall be provided for each total change of 90 degrees in grade or alignment. In no case shall the spacing of cleanouts exceed 100 feet. No cleanout will be required at the connection of the side Sewer to a riser on the public Sewer. A suitably located cleanout in the house piping or plumbing may be considered as a cleanout for the side Sewer. Cleanouts shall consist of a wye branch in the side Sewer. All cleanouts located in the Right Of Way shall be extended to finish grade.

The extension of cleanouts to finish grade on private property is optional with the property owner. When extended to finish grade, cleanouts shall be full side Sewer diameter and shall be extended to a point not less than 6 inches nor more than 12 inches below the finished ground surface with a removable stopper which prevents passage of dirt or water. When specified in the Contract, the Contractor shall install an approved casting to provide ready access to the cleanout stopper. An 1/8-bend shall be used to deflect the side Sewer upward as a cleanout where the terminal end of the side Sewer lies upstream from the last point of connection.

Pipe joints shall be the type specified in Section 7-17.3(2).

Trench excavation, bedding, and backfill requirements shall comply with the appropriate requirements of Section 7-17. The trench excavation shall be made in such a manner as to provide an undisturbed base upon which the pipe shall be placed. Bedding around the wye and under the pipe connecting to the wye shall be thoroughly compacted. Otherwise, construction shall conform to the requirements shown on Standard Plan no. 280.

7-19.4 MEASUREMENT

Bid items of Work completed pursuant to the Contract will be measured as provided in Section 1-09.1, Measurement of Quantities, unless otherwise provided for by individual measurement paragraphs herein this Section.

Measurement for "Sewer Cleanout, (Size)" will begin at the wye branch and extend through the casting, as shown on Standard Plan no. 280.

7-19.5 PAYMENT

Compensation for the cost necessary to complete the work described in Section 7-19 will be made at the Bid item price Bid only for the Bid item listed or referenced as follows:

1. "Sewer Cleanout, (Size)", per each.

The Bid item price per each for "Sewer Cleanout, (Size)" shall include all costs for the work required for furnishing and installing the wye, Sewer pipe, pipe bands, pipe plug, casting, and concrete collar.

SECTION 7-20 ADJUSTMENT OF NEW AND EXISTING UTILITY STRUCTURES TO FINISH GRADE**7-20.1 DESCRIPTION**

Section 7-20 describes work consisting of adjusting new and existing manholes, catch basins, inlets, valve chambers, water meter boxes, handholes, and similar utility Structures encountered during the Work to a new grade elevation. The work shall include adjustment by removing or installing ring extensions; by removing and installing adjustment brick; by removing or adding a vertical riser section to the utility Structure; by removing and rebuilding a portion of the existing Structure; or by any combination of the preceding methods.

Publicly-owned utility Structures shall be adjusted to finished grade by the Contractor. Privately-owned utilities are generally in the streets and road Rights of Way pursuant to franchises or to rights claimed under the laws of the United States of America, or the State of Washington and, therefore, these utility agencies are responsible for all adjustments and relocations of their own facilities. The Contractor shall schedule the Work so that utility adjustments by others can be accomplished without undue delay.

The requirements of Section 7-20 apply to utility Structures constructed from precast concrete sections, masonry brick or blocks, and cast-in-place concrete.

7-20.2 MATERIALS

Material used in the adjustment of existing utility Structures shall meet the requirements for new construction specified in the Specification Section applicable to the item being adjusted.

Adjustment ring extensions shall meet the requirements of Section 9-12.8 and Standard Plan no. 231.

Epoxy used to secure manhole castings for ring extensions to existing frames shall be per epoxy manufacturer's recommendations for the material application. The Contractor shall submit at least 3 Working Days in advance, a Manufacturer's Certificate of Compliance and catalog cut stating the proposed epoxy provides acceptable bonding performance for the intended application.

7-20.3 CONSTRUCTION REQUIREMENTS**7-20.3(1) ADJUSTMENT OF MANHOLES, CATCH BASINS, AND SIMILAR STRUCTURES****7-20.3(1)A GENERAL**

The Engineer will establish approximate grade elevation for the tops of existing utility Structures requiring adjustment. The final alignment and grade elevation shall be established from adjacent roadway surfaces, forms, or such offset hubs as may be provided by the Engineer.

Except where adjustment is to be made by ring extension, the Contractor shall remove the pavement around the casting; remove the casting and install or remove leveling or adjustment brick or block; or shall excavate around the utility

structure, remove a portion of it as necessary and rebuild the structure to meet the new grade elevation. Pavement removal shall be kept to the minimum amount required to facilitate the adjustment. Adjustment of drainage Structure to finished grade elevation, by whatever method, shall result in a finished Structure meeting the requirements for new construction as specified in Section 7-05.3(1)P, except inlets which shall comply with Section 7-05.3(2)D. The overall distance between the top of the casting to the bottom of the adjustment brick shall be not more than 26 inches.

Where a Water Main casting adjustment is required and the concrete pavement or concrete rigid pavement base is to be made thicker, the Contract will specify whether or not a new Water Main casting is required. If a new Water Main casting is required, the Contractor shall comply with the requirements in Section 7-20.3(5); otherwise, adjustment of Water Main castings shall be by either brick or concrete block. The adjustment of Water Main castings with ring extensions will not be allowed.

When a ring extension is specified in the Contract, it shall be epoxied securely to the existing frame. All frame and ring extension surfaces to receive the epoxy shall be thoroughly cleaned with a wire brush prior to the application of epoxy.

When adjustment is made by adding or removing leveling bricks, all joints in the bricks shall be filled with mortar and the casting seated in mortar on the top brick course.

After the utility Structure has been adjusted to grade, and the Structure made watertight by plastering with a mortar cement, all voids around the Structure shall be backfilled and compacted with imported Mineral Aggregate Type 17. The casting shall then be secured in place with a tapered layer of concrete or asphalt, as applicable.

The Contractor shall adjust to finish grade, water meter boxes encountered in the planting strip and sidewalk area.

Should adjustment to a water meter box necessitate adjustment or relocation of the water meter, the Contractor shall notify the Engineer at least 3 Working Days in advance and the water meter will be adjusted or relocated by SPU Water Operations. The Contractor shall then make final adjustment of the meter box.

7-20.3(1)B UNPAVED STREET GRADING PROJECTS

New manholes, catch basins and similar Structures constructed in conjunction with street grading projects which are to be surfaced with gravel or crushed stone shall be constructed to a point approximately 8 inches below the subgrade and covered with a temporary wood cover. Existing manholes encountered shall be cut off and covered in a similar manner. The Contractor shall carefully reference all manholes so that they may be easily found upon completion of the street work.

After placing the gravel or crushed stone surfacing, the utility Structures and utility castings shall be constructed to the finished grade of the roadway surface. Excavation necessary for bringing utility castings to grade shall center about the utility structure and be held to the minimum area necessary. After completion of the utility structure adjustment, and after the structure is made watertight by plastering with mortar cement, the void around the manhole shall be backfilled with imported Mineral Aggregate Type 17 and thoroughly compacted.

Where bituminous surface treatment is to be placed, the manhole castings shall be installed from 1/2 inch to 1 inch higher than the rock surfacing so that the top of the casting matches the finished roadway surface.

7-20.3(1)C CEMENT CONCRETE PAVING PROJECTS

Manholes, catch basins and similar Structures shall be constructed or adjusted in the same manner as outlined in Section 7-20.3(1)A except that the final adjustment shall be made and the cast iron frame set after the forms have been placed and checked. In placing the concrete pavement, extreme care shall be taken not to alter the position of the casting in any way.

All Standard Plan nos. 230 and 361 castings (manholes and valve chambers) installed in and requiring new concrete pavement or rigid concrete base pavement, shall comply with the reinforcing requirements of Section 5-05.3(9).

See Section 7-20.3(1)A for Water Main casting adjustment requirements.

See Section 7-20.3(1)D for temporary transition tapers around exposed castings.

7-20.3(1)D ASPHALT CONCRETE PAVING PROJECTS

Utility Structures requiring adjustment of frames to match finish grade shall be adjusted prior to the start of the final paving operation.

The tops of existing utility Structure frames shall be raised or lowered to match the finish grade. Immediately after adjustment of the frame to finish grade in lanes that are to remain open to traffic, the Contractor shall install temporary asphalt or temporary pavement patch transition tapers around the Structure frame to prevent a nuisance to traffic. The Contractor shall maintain the asphalt tapers and shall furnish, install, and maintain warning signs and barricades in accordance with Sections 1-07.23 and 1-10. The Contractor shall remove the asphalt tapers immediately prior to the start of paving operations.

Inside surfaces of adjusted Structure frame and bricks or rings which are disturbed or damaged by the adjustment, as well as the new adjustment area, shall be mortared to give a smooth, watertight surface.

7-20.3(1)E ASPHALT RESURFACING PROJECTS

Adjustment of manholes, catch basins, and similar Structures on asphalt resurfacing projects shall meet the requirements of Section 7-20.3(1)D.

7-20.3(1)F STORM AND SANITARY SEWER OR WATER PROJECTS

Manholes, catch basins, gate valve Structures and other similar type Structures being constructed in conjunction with Sewer or water projects on improved streets shall be brought to final grade as outlined in these Section 7-20 Specifications.

7-20.3(1)G ESTABLISHMENT OF GRADE FOR TOP OF MANHOLE

The Engineer will establish the grade for top of manholes, catch basins and similar Structures; however, these grades will be approximate only. The Contractor shall allow adjustment of frame and frame extensions in accordance with the Standard Plans. The Engineer assumes no responsibility in this regard, except when the final grade is set.

7-20.3(2) ADJUSTMENT OF INLETS

The final alignment and grade of frames for new and old inlets to be adjusted to grade shall be established from the forms or from adjacent pavement surfaces. The final adjustment of the inlet frame and frame extension shall be performed in similar manner to that described for manholes. On asphalt concrete paving projects using curbs and gutters, that portion of the frame not embedded in the gutter section shall be solidly embedded in concrete. The concrete shall extend a minimum of 6 inches beyond the edge of the frame and shall be left 1-1/2 inches below the top of the frame so that the wearing course of asphalt concrete pavement butts against the frame. The existing concrete pavement and edge of the casting shall be painted with hot asphalt cement.

Adjustments in the inlet structure frame and frame extension shall be made in the same manner and of the same Material as that required for new inlets. The inside of the inlet frame and frame extension shall be plastered smooth.

7-20.3(3) ADJUSTMENT OF MONUMENTS, AND FRAME AND COVER

Monuments and monument castings shall be adjusted to grade in the same manner as for manholes.

7-20.3(4) ADJUSTMENT OF VALVE BOX CASTINGS

Adjustment of valve box castings and Water Main castings shall be as specified in Sections 7-20.3(1)A and 7-20.3(5).

7-20.3(5) FURNISHING CASTINGS

Where adjustment of existing utility Structures is required and the Drawings indicate that the existing castings be replaced, the Contractor shall furnish new castings of the type specified on the Drawings with the exception of Water Main castings. Water Main castings requiring replacement will be furnished by SPU Water Operations. Casting shall include frame and grate, or ring and cover unless the Contract specifies otherwise. Salvaged castings shall be cleaned and delivered as specified in Section 2-02.3(7).

7-20.3(6) ADJUST BY SHAFTING

Adjustment of existing utility casting and Structure shall be by shafting when the casting remains the same and one of the following conditions exists:

1. The casting is to be raised, resulting in a total depth of the adjustment brick zone greater than the maximum allowable as indicated on the Standard Plans; or
2. The casting is to be lowered more than the depth of the existing adjustment brick or in excess of 16 inches.

Work required shall include excavation, removal of the existing frame and cover, leveling bricks, cone section or flat slab of the utility structure. The Contractor shall add to or remove from the utility structure as appropriate, the vertical riser section having the least dimension, unless otherwise indicated on the Drawings, to allow the structure to be adjusted to the new grade elevation. The cone section or flat slab shall be reinstalled, adjustment bricks installed, and the existing frame and cover reset. The surrounding void shall be backfilled and compacted in accordance with Section 7-17.3(3).

7-20.4 MEASUREMENT

Bid items of Work completed pursuant to the Contract will be measured as provided in Section 1-09.1, Measurement of Quantities, unless otherwise provided for by individual measurement paragraphs herein this Section.

Measurement for "Adjust by Shafting" will be by the vertical foot of adjustment, from original grade to finish grade.

7-20.5 PAYMENT

Compensation for the cost necessary to complete the work described in Section 7-20 will be made at the Bid item prices Bid only for the Bid items listed or referenced as follows:

1. "Adjust Existing Manhole, Catch Basin or Valve Chamber", per each.
2. "Adjust Existing Inlet", per each.
3. "Adjust Existing Monument Frame and Cover", per each.
4. "Adjust Existing Valve Box", per each.
5. "Adjust Existing Handhole", per each.

The Bid item price for "Adjust Existing (Item)" shall include all costs for the work required to adjust the existing utility casting from original grade elevation to finished grade elevation with or without removing or adding adjustment bricks.

6. "Adjust Existing Manhole, Catch Basin or Valve Chamber With Ring Extension", per each.
7. "Adjust Existing Inlet With Ring Extension", per each.
8. "Adjust Existing Monument Frame and Cover With Ring Extension", per each.
9. "Adjust Existing Valve Box With Ring Extension", per each.

The Bid item price for "Adjust Existing (Item) with Ring Extension" shall include all cost for the work required to furnish and install the required ring extension.

In the case where the Contractor is required to adjust a casting with ring extension as well as making an adjustment by removing or adding adjustment bricks, the Contractor will be compensated for the work under the Bid items "Adjust Existing (Item)" and "Adjust Existing (Item) with Ring Extension".

10. **“Adjust By Shafting”,** per vertical foot.

The Bid item price for “Adjust by Shafting” shall include the costs for all work required to modify the existing structure and complete the adjustment to the grade elevation as specified.

11. **“Utility Casting, (Type)”,** per each.

The Bid item price for “Utility Casting, (Type)” shall include the costs for all work required to furnish and install new castings of the type specified in the Contract when existing castings are to be replaced.

When a manhole is required to be rebuilt to accommodate a new casting, the cost of the utility casting shall be included in the price Bid for the Bid item “Rebuild (Item)” per Section 7-05.5 where “item” is “manhole”.

12. **Other Payment Information.**

Costs for adjustment to finish grade of water meter boxes excluding adjustment of the water meter itself; small castings other than inlet, catch basin, manhole, valve chamber, handhole, monument, and water valve box; hydrant valve castings; and private and other public utility castings requiring coordination with the private or public casting owner, shall be included in the Bid item prices for the applicable Bid items and no separate payment will be made.

Mineral Aggregate ordered as backfill in lieu of native Material will be paid as "Mineral Aggregate, (Type)".

Restoration of the roadway surface shall be in accordance with the applicable Section covering the work involved.

The costs for asphalt or cement concrete used to secure castings prior to paving shall be considered incidental to the Work and no separate payment will be made.

All work required to adjust castings of all newly installed or rebuilt utility Structures to finished street grade shall be considered included in the Bid item prices of the Bid items for the appropriate type of utility Structure.

In asphalt resurfacing projects, as specified in Section 7-20.3(1)E, all costs to remove the asphalt concrete and/or concrete base, will be considered included in the Bid item price of the Bid items of work for adjusting the specified Structures.

7-21 NATURAL DRAINAGE SYSTEMS

7-21.1 DESCRIPTION

Section 7-21 describes work consisting of the construction of natural swales alongside vehicular and pedestrian traffic areas to receive surface runoff for infiltration.

7-21.2 MATERIALS

Materials for natural drainage systems will be specified in the Contract and may be one or more of the following:

Natural Drainage Soil and Amendment	9-14.1(3)
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7-21.3 CONSTRUCTION REQUIREMENTS

7-21.3(1) GENERAL

Natural drainage systems are to act both as a filter and to provide a medium for stormwater infiltrating into subsurface soils. When placed as a topping soil, or when placed and mixed with native soils, the Contractor shall employ methods limiting compaction of natural drainage soils to a relative density not exceeding the maximum specified.

Natural drainage soils shall be protected from all sources of additional moisture at the Supplier, in covered conveyance, and at the Project Site until incorporated into the Work. Natural drainage soil placement will not be allowed when the ground is frozen or excessively wet, or when the weather is too wet as determined by the Engineer.

When the Contract specifies testing by a Contractor provided testing laboratory, the laboratory shall be an AASHTO or ASTM or other designated recognized standards organization accredited laboratory with certification maintained current, and Capable of performing all tests to the designated recognized standards specified, and shall provide test results with an accompanying Manufacturer's Certificate of Compliance.

7-21.3(1)A SUBMITTAL

At least 5 Working Days in advance of construction, the Contractor shall submit to the Engineer for approval, a Manufacturer's Certificate of Compliance for the natural drainage soil and component parts demonstrating compliance with the Material Specifications including a 2 gallon minimum size sample provided in an impermeable container. The submittal shall also include an adequate description of the equipment and methods proposed to produce the specified construction.

When the Contract specifies the Contractor to provide a testing laboratory, the submittal shall also include the following information about the testing laboratory: name of laboratory including contact person, address, phone contact, e-mail address; qualifications of laboratory and personnel including date of current certification by ASTM, AASHTO, or approved equal; years in business; description of facilities, and a list of at least three (3) projects within one the year prior to Award of Contract (name of project, project owner, contact person, phone contact, and e-mail address) with the same or greater testing requirements as required in the Contract.

7-21.3(2) NATURAL DRAINAGE SOIL TYPE 1 CONSTRUCTION

At the locations shown on the Drawings, the Contractor shall excavate, grade, and shape to the contours indicated to accommodate the placing of Natural Drainage Soil Type 1 to the thicknesses required. Excavated soil shall be disposed of, or reused elsewhere as a selected material (see Section 2-03.3(10)) as the Contract may specify or the Engineer will allow.

Natural Drainage Soil Type 1 shall be placed in loose lifts not exceeding 6 inch thickness and compacted by proof rolling. The Contract may specify both a minimum and a maximum relative density as a compaction standard.

The minimum coefficient of permeability shall be minimum 1 inch per hour per ASTM D 2434 at a relative soil density adjusted to replicate 85% as determined by ASTM D 1557.

7-21.3(3) NATURAL DRAINAGE SOIL TYPE 2 CONSTRUCTION

At the locations shown on the Drawings, the Contractor shall excavate, grade, and shape to the contours indicated to accommodate the placing of Natural Drainage Soil Type 2 to the thicknesses required. Excavated soil shall be transported to an area where Natural Drainage Soil Type 2 may be prepared.

Natural Drainage Soil Type 2 shall be prepared by mixing 35% Bioretention Soil Type 2 with 65% excavated soils by volume and then thoroughly mixed to form a homogeneous blend. This soil shall then be returned to the excavated area and placed and compacted as a cover material to the thickness indicated. The excavated area shall be cleaned of debris and other deleterious material prior to placement of natural drainage system soil.

Natural Drainage Soil Type 2 shall be placed in loose lifts not exceeding 6 inch in thickness and compacted by proof rolling. The Contract may specify a relative density, or range of relative densities, to be obtained as a compaction standard for the placed soil. The Contractor shall be prepared to employ compaction methods limiting the upper range of compaction.

Prior to placement of Engineered soil, Contractor shall submit certified laboratory test results verifying organic content and permeability of the soil mixture. Organic matter shall range from 4% to 10% as determined by ASTM D 2974. The minimum coefficient of permeability shall be 4 inches per hour as determined by ASTM D 2434 at a relative density of 80%.

The coefficient of permeability shall be minimum 1 inch per hour as specified in ASTM D 2434 at a relative soil density adjusted to replicate 85% as determined by ASTM D 1557.

7-21.4 MEASUREMENT

Bid items of Work completed pursuant to the Contract will be measured as provided in Section 1-09.1, Measurement of Quantities, unless otherwise provided for by individual measurement paragraphs herein this Section.

Measurement for Natural Drainage Soil Construction (Type) will be by the cubic yard.

7-21.5 PAYMENT

Compensation for the cost necessary to complete the work described in Section 7-21 will be made at the Bid item prices Bid only for the Bid items listed or referenced as follows:

1. "Natural Drainage Soil Construction (Type)", per cubic yard.

The Bid item price for "Natural Drainage Soil Construction (Type)" shall include all costs for the work necessary to furnish, place, compact, excavate, grade, shape, mix, dispose of, and as necessary.

7-22 DIRECTIONAL DRILLING

7-22.1 GENERAL

For underground construction or trenchless construction other than directional drilling, see Section 7-17.3(2)J.

Directional drilling is an underground excavation method using a steerable system for installing pipe, conduit and cable using a surface launched drill rig. A fluid-filled pilot bore is drilled using a fluid-driven motor, and the bore is then enlarged by pre-reaming when necessary, and back reaming to the size required for product pipe installation. The drill head steers the pilot boring. The location, depth, and dimension of existing underground facilities, including appurtenances as may exist, within and near the proposed bore path are identified and located, and the bore path alignment and profile through these underground facilities is planned. The location and depth of the drill head following this planned bore path is monitored and known at all times. Notifications and coordination with others whose underground facilities exist along the bore path are pre-arranged and timely made.

7-22.2 MATERIAL

Product pipe, and casing pipe when required, shall be as specified in the Contract.

The tensile strength of product pipe joints, and of casing pipe joints when casing is required or proposed, shall be of sufficient strength to withstand installation stresses and frictional resistances for the size, length, and curvature of the bore.

7-22.3 CONSTRUCTION REQUIREMENTS

7-22.3(1) EXPERIENCE AND QUALIFICATIONS

See the submittal requirement of Section 7-22.3(6)B.

In addition to requirements listed elsewhere in the Contract, the directional drilling crew, whether Contractor or Subcontractor, shall have acceptable training; operational experience; a thorough understanding and working knowledge of all functions of the drilling operation; the ability to promptly identify and correct anything out of the ordinary when it becomes obvious; experience in coordinating drilling operations with facility owners whose facilities may be near or along the bore path; and knowledge of all legal and regulatory requirements that apply to the entire drilling operation.

Acceptable experience shall be interpreted as the operator, and the locator tracking the drill head, each having no less than three (3) full years current directional drilling experience including working knowledge of any industry upgrades related to directional drilling. The crew shall have in-place a coordinated communications system and method of operations to, at all times, maintain control, and readily and promptly recognize and respond to problems.

The drilling Contractor or Subcontractor shall have written guidelines and procedures defining all crew members duties and responsibilities including procedure for identifying and avoiding "strikes" on any type underground facility including appurtenance. Such procedure may include a description of partnering with owners of underground facilities to prevent underground "strikes".

Acceptable training shall be interpreted as the following:

1. In possession of and following the "Horizontal Directional Drilling Good Practices Manual" as developed by a consortium of six (6) industry associations including the North American Society for Trenchless Technology (NASTT), or having and practicing directional drilling guidelines as developed by a consortium of designated and recognized industry organizations having expertise in horizontal directional drilling, drilling equipment, Supplies associated with drilling, and as may be applicable to directional drilling.
2. Attendance at seminars, meetings, and training sessions specific to, or including directional drilling.

The Contract may require additional evidence of experience be provided where drilling is required in sensitive areas (such as but not limited to critical habitat area with threatened or endangered species, wetland, under a river or stream, etc.); where existing underground infrastructure is dense or critical; and as may apply.

7-22.3(2) DRILLING EQUIPMENT

All drilling equipment, whether direct or supporting, shall be well maintained, kept reasonably clean, and have fresh oil, good working parts and packings. Hoses and hose connectors shall be in good working order and have no flaws, and hose connections shall be as recommended by the manufacturer. Flow meters and pressure reading gauges shall be calibrated in accordance with manufacturer's recommendations.

The drilling Contractor or Subcontractor shall have a preventative maintenance program in-place. Such a program shall address regular inspecting and maintaining the drill head, drill frame, engine, hydraulic system, drilling fluid pump, drill pipe and downhole tools, and walk-over tracking system. The drilling Contractor or Subcontractor shall also have a maintenance log showing dates and types of maintenance for the various components. This log shall also show repairs, if and when needed, which equipment part or parts were repaired, what the repair consisted of, and when the repair occurred.

A competent crew member shall inspect and verify each segment of drill string as structurally sound with no cracks, no excessive wear, continuous threads, and no flaws whatsoever before incorporating for use in the drilling operation. Defective drill string will not be allowed and will be considered unauthorized work.

The drilling Contractor or Subcontractor shall be qualified to perform necessary and reliable equipment operation and inspection including the reliability of the drill head locating system. The driller shall also be qualified or have ready access to qualified expertise as may be necessary, in maintaining and repairing the equipment.

7-22.3(3) PROPOSED BORE PATH - PREPARATORY REQUIREMENTS

7-22.3(3)A GENERAL

Before any directional drilling activity begins, the Contractor shall make preparatory measures as applicable and as described in Section 7-22.3(3) and as may be specified in the Contract.

The proposed bore path alignment and profile shall be shown on a plan and profile Shop Drawing including showing drill head and drill string clearances from all identified underground facilities (see Section 7-22.3(20) re: As-Built Drawings).

7-22.3(3)B EXISTING UNDERGROUND FACILITIES

The Contract will identify along and near the proposed bore path, the plan and profile locations of known existing underground facilities and their appurtenances, and other underground features and improvements as they relate to the proposed bore path.

When the Contract specifies a minimum depth of bore and indicates the proposed bore path is below existing underground facilities identified in the Contract, such information provided in the Contract will also identify locations, dimensions, depths, and lengths of permanent ground anchors and deadman systems as may exist.

7-22.3(3)C ONE NUMBER LOCATOR SERVICE – ADDITIONAL REQUIREMENTS

In addition to the requirements of Section 1-07.17, the excavator in its notification to One Number Locator Service, shall provide the following information:

1. the type of excavation is directional drilling,
2. a brief description of the proposed bore path location full length, including its start and finish locations, and range of proposed depths of bore,
3. that the proposed bore path will be adequately surface marked its entire length to aid One Number Locator Service utility locators, and
4. as may be applicable, request "marking" of service laterals and appurtenance, as may be near or along the proposed bore path.

Before notifying One Number Locator Service, the proposed borepath shall be surface marked at regular and frequent intervals unless surface features require increasing or decreasing an interval spacing. These surface markings shall be in accordance with the APWA Uniform Color Code. In areas where surface markings cannot be accommodated or may not be allowed, stakes shall be used and the excavator shall alert One Number Locator Service of such staking.

7-22.3(3)D EXPOSING EXISTING UNDERGROUND FACILITIES

The Contractor shall be prepared to expose underground facilities along the proposed bore path, if the location and depth of facility is indicated near the proposed bore path as can reasonably be done. Such exposure may include a sufficiently sized excavation to allow adequate visual inspection of the underground facility and its environment including the determination of the utility's depth, dimensions, type bedding, appurtenances, and foundation support.

In addition, the Contractor shall be prepared to expose any portion of select underground facilities to a dimension to accommodate examination for damage as law may require.

Such exposure may be required in advance of the drill head reaching the vicinity of the facility such that the drill head can be visually verified complying with a specified clearance.

7-22.3(3)E UNDERGROUND FACILITIES – NO DEPTH INFORMATION OR UNLOCATABLE

For identified but unlocatable underground facilities, and where a facilities depth or its dimensions or appurtenances associated with the facility are unknown, the Contractor shall request the facility owner to provide the best available information.

Where an underground facility is identified and its depth or its dimension or appurtenances associated with the facility are unknown, the Contractor shall request the facility owner to provide the best available information.

The Contractor shall be prepared to expose by excavation, such facilities to verify as needed, location, depth, dimension of facility, appurtenance as may exist, and any bedding rigid and otherwise as they relate to the proposed bore path.

7-22.3(3)F SERVICE LATERAL CONSIDERATIONS

The Contractor shall be aware that an owner of underground facilities is not required to indicate the presence of existing service laterals or appurtenances if the presence of existing service laterals or appurtenances on the site of the construction project can be determined from the presence of other visible facilities, such as buildings, manholes, or meter and junction boxes on or adjacent to the construction site.

The Contract will show the existence of service laterals known to exist by the Engineer at the Project Site.

Proposed directional drilling shall require that identified service lateral facilities be visually identified if near the bore path (see Section 7-22.3(3)C).

The Contract may require advance notification and coordination with public and private underground facility owners with service laterals in the vicinity of proposed bores. In addition, underground facility owners may also require the excavator provide advance notification, coordination, and exposure of facility.

7-22.3(3)G SELECT UNDERGROUND FACILITIES – SPECIAL REQUIREMENTS

Unless the Contract specifies otherwise, in preparing for drilling and when advancing the drill head, it may be necessary that the following underground facilities, and appurtenance as may apply, be adequately exposed to verify the drill head safely clears the underground facility. These exposure locations shall be in alignment with the proposed borepath or advancing drill head. In addition, other underground facility owners may also request this exposure. Such exposure may also apply to service laterals.

Clearance requirements listed in this Specification may be greater than those listed in Section 1-07.7(2) and if such be the case, these listed clearances shall take precedence. If no clearance is specified in this Specification, the clearances specified in Section 1-07.17(2) shall apply.

Select underground facilities that may require such visual verification include, but not limited to, the following:

1. **Seattle City Light electrical transmission and distribution facilities:** No directional drilling will be allowed within the clearance limits of a Seattle City Light underground electrical facility as specified in Section 1-07.17(2) unless SCL has pre-approved such in writing. Should drilling be within or have the appearance of possibly being within said clearance, the Contractor shall make the notification required in Section 1-07.28 item 8C at least 10 Working Days in advance of entering said clearance. Unless the Contract specifies otherwise, the Engineer may require an Electrical Safety Observer be present when the drill head is within said clearance (see Section 1-05.2(2)).
2. **Fiber optic and other communications facilities:** Owners of fiber optic and other communication underground facilities will specify any clearance, notification, and other requirement when such facilities exist at the Project Site. Such communication facilities also include data transmission and control systems that may exist as appurtenance associated with pump stations, electrical stations, Water Main valves, and other type facilities.
3. **Gas facilities:** Other than "pipeline" or "pipeline system", the owner of underground gas facilities may specify clearance, notification, and other requirements regarding their facilities at the Project Site. Also see Sections 1-07.17(1), 1-07.17(2)D and 1-07.28 item 18 for Puget Sound Energy gas facility clearances and notifications, respectively.
4. **MetroKC Sewer and Storm Drain:** MetroKC will specify any clearance, notification, and other construction requirement when MetroKC Storm Drain, or Sewer exist at the Project Site.
5. **"Pipeline" or "pipeline system":** The Contractor shall comply with Ch 19.122 RCW.
6. **Water Main:** Clearance from Water Main, appurtenance, and surrounding bedding shall be a minimum three (3) feet beyond the neatline dimensions as indicated on the 300 series Standard Plans.
7. **Underground ground support systems:** Ground support systems and deadman anchor systems may exist within the Project Site and may be in the vicinity of a proposed bore path. Such ground support systems may be tiebacks, ground anchors, soil nails, deadperson systems, and other similar type systems. Such ground support

systems are used for permanent and for temporary purposes, and may be loaded or unloaded. The Contractor shall plan the bore path to avoid such ground support systems. Permanent ground support systems known by the Owner to exist at the Project Site will be shown in the Contract.

The Contract may specify clearances, notifications, and other requirements for other underground facilities not listed above.

The Contractor shall also be prepared to accommodate any request of the owner of an underground facility the Contract does not address where the proposed or actual bore path crosses or is within a clearance as defined by that facility owner. When such happens, the Contractor shall promptly notify the Engineer.

7-22.3(3)H VERIFICATION OF FACILITIES - EXISTING AND AS INDICATED IN THE CONTRACT

In preparing a drilling bore path alignment and profile, the Contractor shall verify and compare the as indicated in the Contract underground facility locations, depths, dimensions, and appurtenances, with the actual facility locations, depths, dimensions, and appurtenances, and with the proposed bore path alignment and profile.

Where conflict is indicated, such conflict shall be resolved before drilling can begin.

7-22.3(4) PROGRESS SCHEDULE CONSIDERATION

The Contractor's Progress Schedule shall take into consideration the two (2) phases of directional drilling as follows:

- Phase 1 This preparatory phase shall accommodate exploration and discovery, and may require possible suspension for this portion of Work, or suspension of the Work to address a safe and coordinated, drilling operation and bore path alignment and profile, and
- Phase 2 The actual drilling operation.

Drilling shall be completed in one continuous and uninterrupted operation, unless conditions arise that require interruption. Such conditions include, but are not limited to, health and safety, damage or the potential for damage, environment, permit, and "frac outs".

7-22.3(5) ACTIVE AND PASSIVE INTERFERENCES AND DRILLING EQUIPMENT

In preparing for the drilling, the Contractor shall "walk the proposed bore path" with locating equipment as it relates to tracking the drill head, and shall identify areas of active interferences and passive interferences that may impact location readings of the drill head by the Contractor's locating equipment.

Such interference areas shall be identified on the proposed bore path alignment and profile Shop Drawing.

The Contractor shall be prepared to discuss how the actual drill head location, depth, and direction shall be determined, and be kept on the proposed alignment and along the proposed profile where such interferences exist.

The Contractor locator shall "locate" the drill head in all indicated interference areas and shall record the readings in the Daily Log and as-Built Drawings.

7-22.3(6) SUBMITTAL

7-22.3(6)A GENERAL

Unless the Contract specifies otherwise, the submittal on Qualifications shall be returned from the Engineer to the Contractor (Section 7-22.3(6)B), before the Contractor submits the Preparations Required Before Beginning Drilling (Section 7-22.3(6)C). (**NOTE** – the Qualifications Submittal may be required as part of the pre-award information process (Section 1-03.1(4) and shall not be a substitute for this submittal requirement.)

7-22.3(6)B SUBMITTAL – QUALIFICATIONS

At least 10 Working Days in advance of beginning preparatory requirements, the Contractor shall submit information describing qualifications of crew, equipment, and drill head tracking, as follows:

1. Identify the directional drilling crew members including operator and locator, and mudperson as may apply, and include a description of directional drilling experience, training, and qualifications to perform a safe and acceptable installation. Unless the Contract specifies otherwise, a list of the most recent three (3) directional drilling projects for these crew members shall be included showing:
 - 1) each project's name and total price paid by the project owner for the drilling;
 - 2) the project owner, an owner contact person knowledgeable of the drilling, current contact phone number, and e-mail address;
 - 3) type and size of pipe installed, and if casing used, size and type of casing including annular space filler if used;
 - 4) length and range of depths of bore, and if any curvature in the bore path, why and what were the circumstances;
 - 5) site conditions for each project including underground infrastructure density and types, active and passive interferences and how dealt with, groundwater and controls, and a description of drill head depth and location verification procedure as it related to the proposed bore path alignment and profile;
 - 6) any specific constraints required of the drilling, such as drilling on a slope or in a critical habitat area or under a body of water or in a very dense underground infrastructure environment or near critical underground infrastructure, and how addressed; and

- 7) problems encountered including whether they were identified before the drilling began or were encountered during the drilling, and how resolved.

In particular, 1 of these projects shall be similar to site conditions and contractual constraints similar for this project to assist the Engineer in evaluating qualifications.

2. List and describe the equipment and Supplies as they relate to the directional drilling. The submittal shall indicate that all equipment is safe, fully operational, maintained as recommended by the equipment manufacturer, and is in a condition to acceptably and safely perform the drilling. Describe how the operator maintains control of the drill head and how the operator knows the condition and status of all associated with the drill head to maintain the proposed bore path alignment and profile. The submittal shall include the manufacturer, make, model, and year purchased for the drill rig, and parts thereof if not of the same manufacturer. The submittal shall also include the drilling equipment manufacturer's recommended as well as the actual maintenance and repair program.
3. Describe the "locate" equipment and procedure used by the locator to track the drill head. Describe how the Contractor ensures the "located" drill head location and depth readings match the actual location and depths in areas of passive interference, in areas of active interference, and in non-interference areas. Describe equipment or portion of equipment used by the operator to know the location, depth and attitude of the drill head, and how the drill head's projected bore path relates to avoiding identified underground facilities including clearances and appurtenances as may apply. Describe the type and strength of battery used in the drill head, the calibration of drill head transmitter with Contractor locator receiver, and how the Contractor evaluates these needs for Project Site conditions and proposed bore.

7-22.3(6)C SUBMITTAL - PREPARATIONS REQUIRED BEFORE BEGINNING DRILLING

After the Engineer returns the qualifications submittal to the Contractor without requiring resubmittal, and before beginning drilling, the Contractor shall submit it to the Engineer at least 10 Working Days in advance, the following information indicating a well-planned and safe drilling operation:

- 1) A plan and profile Shop Drawing of the proposed bore path alignment and profile full length showing all existing underground facilities as they relate to the drilling including appurtenance as may exist, clearances as may be required, areas of active and passive interference, locations of launch and receiving locations or pits, and safe working zone.
Also see Section 7-22.3(20)C for As-Built Drawing requirements.
- 2) In areas of active and passive interference, explain how these interferences may impact knowing where the drill head is, where the drill head is going, what the attitude of the drill head is, the degree of uncertainty, and explain how the Contractor intends to compensate for these interferences and uncertainty ensuring the drill head follows the proposed bore path alignment and profile.
- 3) Describe the bend radius Capability and limitations of the drilling equipment, including drill head, drill string, product pipe, casing if required, product pipe joints, and drill string joints. Also describe how the Contractor ensures stresses at pipe joints do not exceed joint strengths recommended by the drill string and product pipe manufacturer.
- 4) List all underground facilities' owners where notification, coordination, and uncovering arrangements have been arranged including who the contact is, how contact is made, and any pre-arranged requests of these owners.
- 5) Describe the drilling mud and component parts, and in particular, how monitor the mud quality, filter the mud, and how adjust the mud for filter cake and gel strength needs as the drill head advances and mud conditions indicate.
- 6) Describe the controls to prevent environmental pollution, to stay within environmental constraints where specified in the Contract (such as drilling under bodies of water or in wetlands or in critical habitat area or other area as defined in SMC 25.05.098, etc.), and how containment of drill waste is proposed in the launch and receiving locations or pits. If groundwater is indicated and may exit at the launch or receiving areas, describe proposed treatment facilities and how discharge.
- 7) Describe controls to maintain safe working conditions and conditions safe where the public may be at risk, such as at the launch location and receiving location.
- 8) If drilling on a slope, see Section 7-22.3(17).
- 9) Provide MSDS for all Supplies and materials as may be used.
- 10) If the proposed bore path is deep to avoid underground utilities, describe and show the locations of permanent ground support systems, underpinnings, and deadman systems, and how the proposed bore path does not interfere with or damage such ground support systems.
- 11) Provide copies of all permits required and obtained for the drilling operation if not required by other Specifications.

No drilling will be allowed until the Engineer has reviewed and has returned this submittal, with no requirement for resubmittal.

7-22.3(7)C SUBMITTAL – REQUIRED AFTER COMPLETION OF DRILLING

Within 5 Working Days of completing the installation of product pipe in the bore, the Contractor shall submit a copy of the Daily Log and As-Built Drawing as specified in Section 7-22.3(20).

7-22.3(8) PRE-DRILL MEETING AND OTHER MEETINGS

Before the Contractor begins directional drilling, and on each day of directional drilling as may apply, a pre-drill meeting shall be held with the Contractor, drill operator and locator, and the Engineer. Such meeting may include the briefing/tailgate conference with the Electrical Safety Observer as specified in Section 1-05.2(2), and may include other utility owners.

The intent of the meeting is to verbally walk through the proposed bore path and drilling operation; notifications and coordinations; location specific controls and monitoring; open communication channels between the driller, Contractor and Engineer; required entries to the Daily Log and updating of the As-Built Drawings; ensuring the drilling is conducted safely and is under control; that the actual drilling alignment and profile matches the proposed submitted bore path alignment and profile; as the Engineer may determine; and as the Contractor may need to be made known.

7-22.3(9) MONITORING THE BORE

The Contractor shall verify to the Engineer that the Contractor's directional drilling results in the following:

1. the actual bore path of the drill head follows the proposed bore path in both alignment and profile, and
2. the indicated readings of depth and location of the drill head by the Contractor's locator match the actual location and depth of the drill head as verified by exploratory or other type excavation, and
3. all underground facilities are identified and that there locations are confirmed, and the bore path indicates clearances with all underground facilities.

Unless the Contract specifies otherwise, the Contractor shall within the first 50 feet of the launch location or pit and at additional locations determined by the Engineer, make a surface locate reading of the drill head location and depth, and shall then mark the surface directly over the indicated drill head location with the read location and read depth.

At locations of active interference and at locations of passive interference, the Contractor shall make surface readings of the drill head location and depth, and shall then mark the surface directly over the indicated drill head with the locator indicated location and depth.

At any time and at any location, the Engineer may require the Contractor to locate the drill head and read its depth, and mark the surface as described in the previous two paragraphs.

At any of these drill head reading locations and as the depth of the drill head may allow, the Engineer may require the Contractor to provide exploratory or other type excavation in advance of the drill head to enable visual verification of the drill head passing through the excavation including verifying drill head depth.

Should a discrepancy be identified including, but not limited to:

- 1) the indicated reading of the location or the depth of the drill head differing from the proposed bore path alignment or proposed profile.
- 2) the indicated reading of the drill head's location or depth differ from the actual visual verification of drill head location or depth,

then such a situation may be considered defective work or unauthorized work.

Directional drilling discrepancy that reasonably appears to potentially create an unacceptable condition, including, but not limited to:

- (1) an unsafe or potentially unsafe condition, or
- (2) that may result in damage or the potential for damage, or
- (3) that may be in violation of law, regulation, code, or other condition of the Contract,

may be cause for the Engineer to order the drilling operation be stopped in its entirety.

When such a condition occurs, the Contractor shall submit a remedy that addresses, as applicable:

- a. controls or adjustment of controls that indicate the drill head shall proceed with the attitude of staying on the proposed alignment and profile,
- b. correction of the current drill head attitude to return the drill head to the proposed alignment and profile,
- c. controls or adjustments to locating and tracking equipment ensuring locator indicated drill head location and depth actually match actual drill head location and depth,
- d. if the difference in actual location or depth of the drill head and the proposed alignment and depth of the drill head is significant, and underground facilities are indicated near or in the path of the advancing drill head, then the Contractor may be allowed to propose a corrected bore path alignment and profile from its existing location to return to the submitted bore path alignment and profile, and shall indicate both where that return location shall be and that the attitude of the drill head at the proposed return location is aligned with the proposed bore path alignment and profile. Such remedy may require additional applicable preparatory work as may be necessary in accordance with Section 7-22.3(3) ensuring clearance with all underground facilities.
- e. if the difference in actual location or depth of the drill head and the proposed alignment and depth of the drill head is significant, and underground facilities are indicated near or in the path of the advancing drill head, then the Contractor may be allowed to propose pullback and redrill. See Section 7-22.3(21).

The Contractor may resume drilling after the Engineer returns the proposed remedy without requiring resubmittal.

Should the Contractor not be able to restart drilling, this will be considered defective work.

All Contractor located drill head location and depth readings, and actual visually verified depth and location readings, shall be shown on the plan and profile Shop Drawing as it relates to the proposed bore path, and shall be recorded in the Daily Log.

As necessary and where necessary, the Contractor shall also “step outside the proposed bore path” to aid in making more accurate locate readings of actual depth and actual location of the drill head where interferences exist.

7-22.3(10) LOCATE TRACKING SYSTEM

The drill head locate system shall be of the strength and type for tracking with the greatest confidence, the drill head following the intended bore path alignment and profile including providing readings in areas of indicated active and passive interferences. The batteries in the transmitter and receiver shall be fresh, and shall be of the strength and type required for the conditions expected of the proposed bore path and Project Site conditions. The transmitter at the drill head shall be adequately calibrated with the receiver to overcome indicated interferences including obtaining readings that may be required on either side of the bore path where such information increases confidence of the readings.

At the beginning of each shift, and at the beginning of each day, the tracking and locating equipment shall be calibrated.

Locator readings, exploratory and other type excavation verification, and the status of batteries and locating equipment including any repair shall be recorded in the Daily Log and on the As-Built Drawings as applicable (see Section 7-22.3(20)).

7-22.3(11) LAUNCH AND RECEIVING LOCATIONS AND PITS

Unless the Contract specifies otherwise, the Contractor shall select the locations of the launch (entry) and the receiving (exit) locations best suited for all necessary for the directional drilling operation. Such entry and exit locations may be pits or excavations. As necessary and where necessary, such locations shall include adjacent area for safe working zone (Section 7-22.3(19)); support, staging, and related needs; bend radius considerations (Section 7-22.3(13)); bore path alignment and profile and clearances with existing underground infrastructure (Section 7-22.3(3)); depth of the launch pit and the receiving pit to allow for entry and exit angles; entry and exit pipe elevation; containment of drill waste (spoils), groundwater treatment and discharge, and as may be identified for safe and acceptable performance.

7-22.3(12) MATCH SITE CONDITIONS

The Contractor shall match the drill equipment and Supplies to the soils and Project Site conditions.

7-22.3(13) BEND RADIUS

The Contractor shall take into consideration the allowable bend radius capabilities of drill string, product pipe, casing pipe when applicable, and the drilling equipment. Bending at any joint of drill string or any pipe shall be within that product manufacturer's recommended tolerances.

These bend radius considerations shall be taken into consideration in proposing the bore path alignment and profile including expected directional adjustments along bore path. The allowable bend radius of product pipe, of casing pipe when applicable, of drill string, and of drill equipment shall be compatible and shall not present a condition for overstressing pipe, joint, casing when applicable, drill string, and equipment.

7-22.3(14) PREREAMING AND BACK REAMING

Prereaming may be necessary to incrementally enlarge a pilot bore to a size to accommodate acceptable product pipe installation. Backreaming enlargement of the bore hole shall allow for minimizing frictional resistance during installation of the product pipe, and for allowing removal of spoils while installing the product pipe. Pipe joint tensile and bend strengths shall not be exceeded during product pipe installation.

7-22.3(15) DRILLING MUD

For the drilling mud, the Contractor shall maintain and adjust “filter cake” and “gel strength” needs; shall have adequate monitoring equipment and Supplies in-place to clean mud for re-use; shall amend mud with additives as progress and conditions dictate; and shall maintain adequate quantity of mud as the bore progresses and as the mud quality indicates.

The Contractor shall continuously monitor mud quality and spoils content as they relate to “filter caking” and “gel strength”.

When excessive spoils content in the mud is indicated for a relatively short length of bore progress, the Contractor shall note such in the daily log including the location and depth of the drill head when such condition is noticed, any underground facilities that are near or over or under the drill head, the type spoils or description of spoils to indicate the material being “lost”, and the date and time of day this occurs. The Contractor shall also immediately notify the Engineer of this condition and shall be prepared to stop the drilling if a condition exists where an excessive loss of soil may have detrimental impacts to surface or other underground improvements. The Contractor shall confirm that excessive loss of soil is not occurring and is not adversely impacting any existing facility or improvement.

The Contractor shall identify locations of “frac outs” or “uncontrollable loss of mud” along the bore path as they are indicated. This information shall be entered into daily log and shall include location of drill head, depth of drill head; time of day; date; estimated amount of lost mud; and if a surface loss, how contained and cleaned up.

7-22.3(16) ENVIRONMENTAL CONTROL

The Contractor shall employ environmental controls in containing and handling spoils, mud, waste, additives, and other pollutants of any kind that are in compliance with law, code, regulation, and as may be required in the Contract.

The Contractor shall also have on-call and shall be able to respond within very short notice, a vector truck with a minimum two (2) cubic yard storage capacity and with adequate ability to extract, any drill waste or mud that may appear at any location at any time, such as a "frac out". Other Supplies that absorb and contain mud and as may be associated with the drilling shall be readily available. Also see Section 1-07.5 for required environmental controls.

The Contract may specify additional constraints when proposed drilling is within environmentally critical areas, critical habitat areas, other sensitive areas, and as required by permit.

7-22.3(17) SLOPE DRILLING AND SUBMITTAL REQUIREMENTS

When drilling on slopes, and in particular on landslide prone slopes, the Contractor shall have controls in-place to control the flow and release of groundwater and any resulting buildup of hydraulic head, the flow and release of drilling mud and any resulting buildup of hydraulic head, and the influence and control of vibrations resulting from any part of the directional drilling operation and product pipe installation.

The Contractor shall promptly cease drilling and shall promptly alert the Engineer of any condition where excessive groundwater is indicated and where the stability of the slope or any part of the slope may become questionable.

Unless the Contract specifies otherwise, prior to the start of any directional drilling on any slope, the Contractor shall include in its submittal to the Engineer, a detailed drawing and a description of controls of how the Contractor proposes to drill on the slope. The following shall be addressed in this submittal as may apply:

- 1) Direction of drilling all pilot holes, any pre-reaming, and the backreaming – upslope, downslope, or crossing the slope;
- 2) The control of drilling mud and groundwater hydraulic head build-up including how prevent the potential for sudden loss of fluid on the slope;
- 3) The influence of vibrations generated by any part of the directional drilling operations on the stability of the slope or parts of the slope including minimizing adverse impacts of vibrations;
- 4) Installation of any temporary subsurface drain to assist in the relief of hydraulic build-up;
- 5) If drilling uphill, installation of any controlled outlet at the launch location or pit that captures and controls groundwater and drilling mud that may follow the drill string, any required treatment and how discharge;
- 6) If drilling uphill, how lubricate the drill head;
- 7) If drilling downhill, how the build-up of hydraulic head along the drill string and at the drill head due to drilling mud and any groundwater is kept under control;
- 8) If drilling downhill, how remove spoils;
- 9) How the drill head location and depth will be tracked and verified on the proposed bore path alignment and profile, and the proposed frequency of locator tracking of the drill head;
- 10) How the Contractor shall reduce hydraulic head in any and all boring holes where pullback of the drill head has occurred and redrilling a new bore path is initiated. Also address how the abandoned bore path(s) is(are) backfilled, how hydraulic head build-up is prevented, and how stability of the slope is not reduced. See Section 7-22.3(21).

7-22.3(18) PERSONAL PROTECTIVE EQUIPMENT (PPE)

The Contractor shall comply with all applicable safety rules and standards including those recommended by designated and recognized directional drilling and trenchless technology industry organizations. All equipment shall be grounded. The operator's station shall be electrically isolated and protected. Boots, gloves and other as necessary clothing shall provide protection from potential hazards associated with directional drilling including contact with underground facilities.

7-22.3(19) SAFE WORKING ZONE

The area surrounding the launch location or pit and the receiving location or pit shall be secured as a safe working area to protect the public from potential hazards associated with directional drilling.

7-22.3(20) DAILY LOG AND AS-BUILT DRAWING

7-22.3(20)A GENERAL

The Contractor shall keep daily written records (a "Daily Log") of all daily progress and events, and a copy of the proposed bore path updated to reflect the actual bore path (As-Built Drawing).

The Daily Log shall be coordinated with and shall reference the As-Built Drawings, and the As-Built Drawings shall reference entries in the Daily Log where appropriate.

The Daily Log and As-Built Drawings shall be kept at the Project Site and shall be made available to the Engineer upon request.

See Section 7-22.3(7)C for submittal requirements.

7-22.3(20)B DAILY LOG

Entries to appear in the Daily Log shall be recorded as they occur, or if unable, a brief entry shall be made in the diary stating that additional explanation shall be provided at end of Working Day. Typical entries to the Daily Log shall reference entries on the As-Built Drawings as applicable and shall include, but are not limited to, the following:

1. notifications made to utility owners including date notified and a summary of any requirement made by the utility owner beyond a simple notification.
2. utility owners on-site visits including name of individual(s), phone and e-mail contact information, date, time of visit, and a summary of any requirement and observation made by the utility owner.

3. communications made by utility owners to the Contractor beyond those in items 1 and 2, and a summary of any request made by the utility owner.
4. for locations shown on the As-Built Drawings of locator tracking of the drill head and the indicated depth of drill head at that location, and if exploratory or other type excavation was used to verify location and depth of drill head, state the results. See Sections 7-22.3(9) and 7-22.3(10).
If in an area of active or passive interference, so state which interference and describe additional measures used to verify locator indicated drill head location and depth. See Section 7-22.3(5).
5. for As-Built Drawings showing exploratory and other type excavation's location and depth not addressed in preceding item 4, include a description of the purpose of the excavation and state the findings. Reference the As-Built Drawings where exploratory or other type excavation was used or was required to verify drill head clearance with underground facility, and state results including identifying which underground facility.
6. describe mud status including changes in, adjustments made to mud content or quality, and reasons for adjustment. State the distance of the drill head from the launch location or pit where adjustment to mud content was required. Also state the location of the drill head when a significant loss of mud is indicated. See Section 7-22.3(15) for Daily Log entry requirements.
7. describe daily progress made. Start with time of day beginning drilling and list how far drill head advanced at each succeeding hour. Also list time of day of drill head reaching exit location, and state the time of day for items 1, 2, 3, 4, 5, and as applicable, 6, 9, and 10 of this Specification subsection.
8. describe how groundwater that flowed into any launch or receiving location or pit, and any dewatering that may have been done, was treated including how discharged or disposed of. See Section 7-22.3(11).
9. if pullback and redrill was performed, describe why such a condition occurred, the reasons for the revised bore path, and how the abandoned bore void was filled including description of void filling material.
10. describe pre-reaming and back-reaming as may be applicable, and the installation of product pipe. If casing was used, include this in the description, and include a description of annular space filler and how installed, if applicable.
11. other information as may be required by the Engineer (Section 7-22.3(8)), by the Contract, or as may be necessary by the Contractor for documentation purposes.

7-22.3(20)C AS-BUILT DRAWINGS

The As-Built Drawing shall be the proposed plan and profile bore path alignment and profile and shall show existing underground facilities, including their dimension, depth, any appurtenance, and proposed and required clearances.

Unless the Contract specifies otherwise, As-Built Drawings shall be Shop Drawings on 24 inch by 36 inch 20 pound bond paper. Horizontal scale shall be 1" = 20' and vertical scale shall be 1" = 10'. The Contractor may provide a continuous sheet (any length greater than 36 inch) with a 24 inch minimum width and same horizontal and vertical scales.

As the bore progresses, the following shall be shown on the As-Built Drawing as applicable:

- 1) locations of entrance and exit locations, and details of pits if used. Identify safe working zone(s), locations of equipment and Supplies, and as may be used for the drilling. See Section 7-22.3(11).
- 2) locations of locator tracking of the drill head and the indicated depth of drill head at that location, and note that the surface was marked as specified in Section 7-22.3(9). If exploratory or other type excavation was used to verify locator verification reading, show the location of the exploratory or other type excavation performed in advance of the verification reading. Reference the Daily Log entry as to status of visual verification.
- 3) locations of active and passive interference, if applicable (Section 7-22.3(5)). Show locations and depth of exploratory or other type excavations verifying locator drill head readings (Sections 7-22.3(9) and 7-22.3(10)).
- 4) locations of underground infrastructure including depth to facility, dimension of facility, special bedding as may exist, and appurtenance associated with a facility. Clearly identify exploratory or other type excavation locations and depths as required by Section 7-22.3(3).
Clearly identify exploratory or other type excavation locations and depths that were performed during the drilling, and reference the entry in the Daily Log, including "pipeline" and "pipeline system".
- 5) clearly label proposed bore path alignment and profile (Section 7-22.3(6)C), and actual bore path alignment and profile if different. Show entry location and exit location angles for product pipe installation including size pipe and invert elevations at entrance and exit locations.

If the actual bore path alignment or profile or both differ from as shown in the Contract or as proposed (Section 7-22.3(6)C), the Contractor shall show both actual and proposed bore paths and shall clearly identify and label each.

7-22.3(21) PULLBACK AND REDRILL

Should a condition occur that requires pull back and redrilling, before attempting any pull back and redrill, the Contractor shall submit to the Engineer, the reasons for pulling back and redrilling; a procedure for the pull back describing in detail how the resulting void shall be filled with a suitable material; and shall indicate the new bore path alignment and profile.

Should the drilling be "frozen" or a condition arise where progress cannot be made, such a condition will be considered defective work or unauthorized work.

7-22.3(22) TESTING

The Contract may specify testing of the installed pipe or conduit, such as a test specified in Section 7-17.3(4).

7-22.4 MEASUREMENT

Measurements for “Casing Pipe, (Material), (Class), (Size), (Directional Drilling)”, and for “Pipe, (Material), (Class), (Size), (Directional Drilling)” will be by the linear foot of pipe and casing pipe actually installed and successfully tested. Measurement will be from end of pipe to end of pipe whether a pipe end is within a structure or not. No measurement will be made for pit whether an entry pit or an exit pit.

Measurement for “Preparation Required Before Directional Drilling” will be per lump sum.

Measurement for “Exploratory Or Other Type Excavation, (Directional Drilling)” will be per lump sum for all exploratory and other type excavation directly related to directional drilling.

7-22.5 PAYMENT

Compensation for the cost necessary to complete the work described in Section 6-02 will be made at the Bid item prices Bid only for the Bid items listed or referenced as follows:

1. **“Preparation Required Before Directional Drilling”**, per lump sum.

The Bid item price for “Preparation Required Before Directional Drilling” shall include all costs for the work necessary to perform investigatory requirements including necessary exploratory and other type excavation, and to provide preparations required to complete the information in Section 7-22.3(6)C.

2. **“Casing Pipe, (Material), (Class), (Size), (Directional Drilling)”**, per linear foot.

The Bid item price for “Casing Pipe, (Material), (Class), (Size), (Directional Drilling)”, per linear foot, shall include all costs for the work required to furnish and install casing pipe. All cost for filling the annular space when required in the Contract shall be incidental to this Bid item and no separate or additional payment will be made therefore.

3. **“Pipe, (Material), (Class), (Size), (Directional Drilling)”**, per linear foot.

The Bid item price for “Pipe, (Material), (Class), (Size), (Directional Drilling)”, per linear foot, shall include all costs for the work required to directional drill all required by Section 7-22 except for other Bid items in this Section.

4. **“Exploratory or Other Type Excavation, (Directional Drilling)”**, per lump sum.

The Bid item price for “Exploratory Or Other Type Excavation, (Directional Drilling)” shall include all costs for the work required to perform exploratory or other type excavation to accommodate the requirements of Section 7-22.

Payment for exploratory and other type excavation related to preparation required before directional drilling shall be included in the Bid item “Preparation Required Before Directional Drilling” and no separate or additional payment will be made therefore.

5. **Other payment information.**

Payment for all cost for the Electrical Safety Observer shall be in accordance with Section 1-05.2(2).

Payment for all cost for backfilling exploratory or other type excavations within paved areas of the Right-of-Way that are associated with directional drilling shall be incidental to the various Bid items and no additional or separate payment will be made therefore.

Payment for all costs for surface restorations associated with directional drilling shall be in accordance with the various Bid items in the Contract.

All costs for daily log shall be included in the various Bid items and no separate or additional payment will be made therefore.

All cost for submittals shall be as specified in Section 1-05.3.